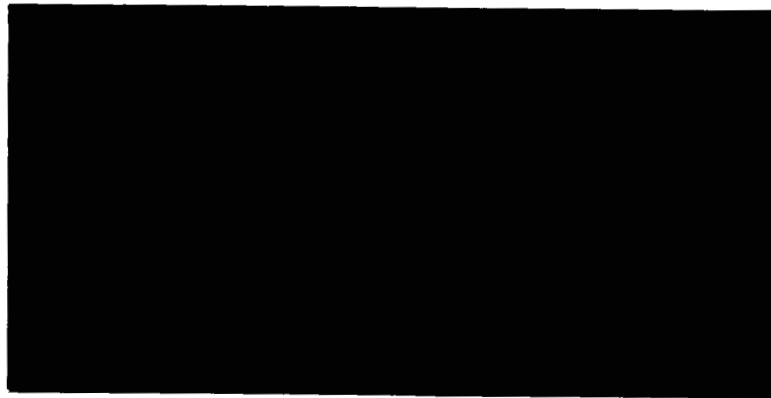


ITT INDUSTRIAL LABORATORIES

FORT WAYNE, INDIANA



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September 28, 1966

HIGH RESOLUTION NIGHTTIME

CLOUD-COVER RADIOMETER

QUARTERLY REPORT XVIII

JANUARY 1, 1966 TO APRIL 1, 1966

Contributors

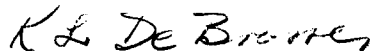
P. C. Murray, W. H. Wallschlaeger, R. Harber,
J. Whitacre, P. Eagle, R. Miller

Under Contract

NAS 5-668

Planetary Radiations Branch
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, Maryland

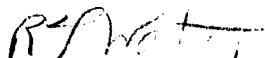
Approved by



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ITT Industrial Laboratories

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1.0 INTRODUCTION

The accomplishments on Contract NAS5-668, Modifications 22, 26, and 27 for the interval between 1 January, 1966 and 1 April, 1966 are included in this report. Certain problem areas and resultant design changes or other solutions are discussed. The engineering model was assembled and partially tested during this reporting period.

2.0 ELECTRONICS

Primary electronic changes were the addition of telemetry and command circuits and elimination of 2N930 transistor from the preamplifier.

Also included in this section is the engineering model circuit board test data.

2.1 Telemetry and Command Changes

Telemetry changes include the addition of the video amplifier telemetry, log amplifier telemetry, and reference telemetry. Command changes include the addition of a capability to switch the AGC between two video outputs.

2.1.1 Telemetry

2.1.1.1 Video Amplifier Telemetry

The circuit is shown in Figure 2.1.1. The circuit consists of an emitter follower for high input impedance and a full-wave rectifier-filter circuit. The circuit is transformer coupled to preserve the balanced line from the video amplifier. Test data is shown in Table 2.1.1.

2.1.1.2 Log Amplifier Telemetry

This circuit is identical to the video amplifier telemetry circuit with the exception of the transformer coupled input. Test data is shown in Table 2.1.1. This data was taken with a 2 volt peak-to-peak modulating signal on the 1500 cps.

Table 2.1.1 Telemetry Test Data

Modulating Frequency cps	Video Amp Telemetry		Log Amp Telemetry	
	Volts dc	mv ripple	Volts dc	mv ripple
0.8	2.1	240	3.2	400
5.0	2.2	60	3.2	30
10.0	2.2	40	3.2	10
100	2.3	10	3.2	10
200	2.3	10	3.2	10
300	2.3	10	3.2	10
350	2.3	10	3.2	10

2.1.1.3 Reference Signal Telemetry

The circuit is shown in Figure 2.1.2. The circuit consists of a voltage divider, a half-wave rectifier, a long time constant circuit and an emitter follower output. The input is taken from one half of the primary of T1 on the reference-AGC board (4708377). Normal output of this circuit is approximately 5 volts.

2.1.2 Command Change

The command change was the addition of a relay to allow the AGC to be switched from TR2 video output to TR1 video output. The relay used is a Potter and Brumfield Type SL11DB with a 12 volt coil. The two sets of contacts are used to provide redundant paths. A diagram is shown in Figure 2.1.3.

2.2 Elimination of 2N930 Transistor from Preamplifier

Because of NASA concern about the radiation effects on the 2N930, an alternate transistor type was sought. No acceptable direct replacement was found and it was decided to use a 2N997 which is a Darlington connection in one TO-18 package. The reason is that this package contains two chips and any radiation deterioration of one or both chips will not deteriorate the over-all performance of the device below an acceptable level. The primary consideration in the selection of a replacement for the 2N930 was its effect on the noise figure of the preamplifier. The preamplifier schematic before the change is shown in Figure 2.2.1 and that after the change as 4708379. The changes were minor bias resistor changes to the 2N997 stage. The NF for the preamplifier with the 2N930 and the 2N997 is compared in Figure 2.2.2. Data was taken using the breadboard preamplifier. To insure the lowest NF, the FET used in the input stage of the preamplifier will be selected. Tests have been run on the qualified FETs and those with the lowest NF are scheduled to be used as input stages.

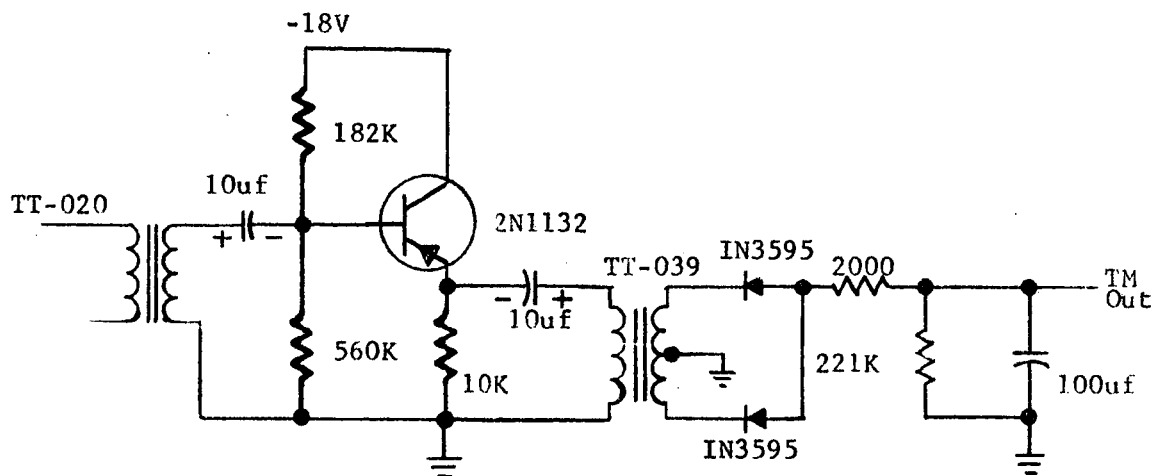


Figure 2.1.1 Video Amplifier Telemetry Circuits

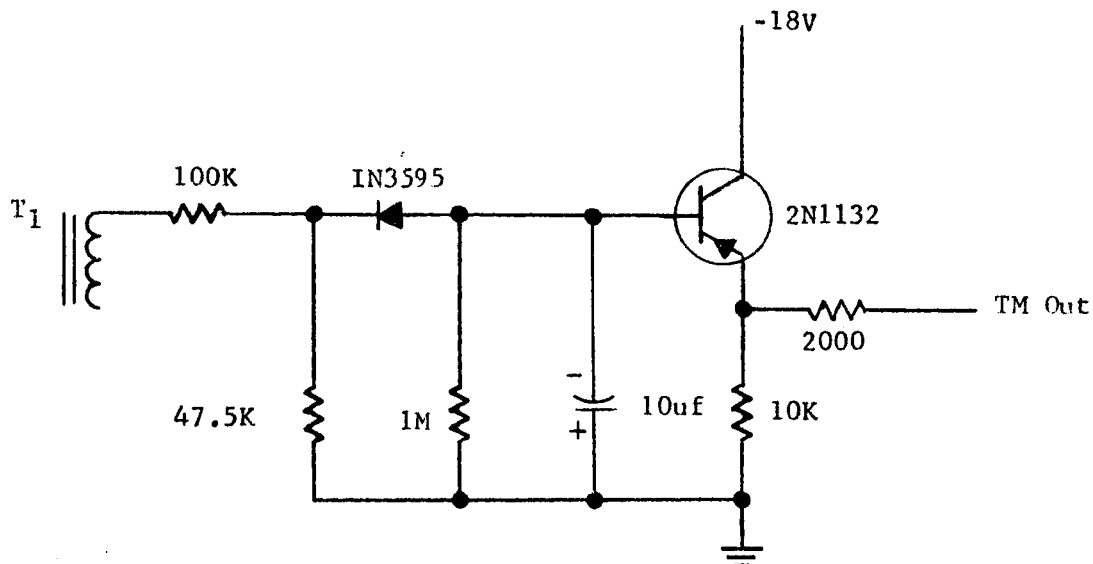


Figure 2.1.2 Reference Signal Telemetry Circuit

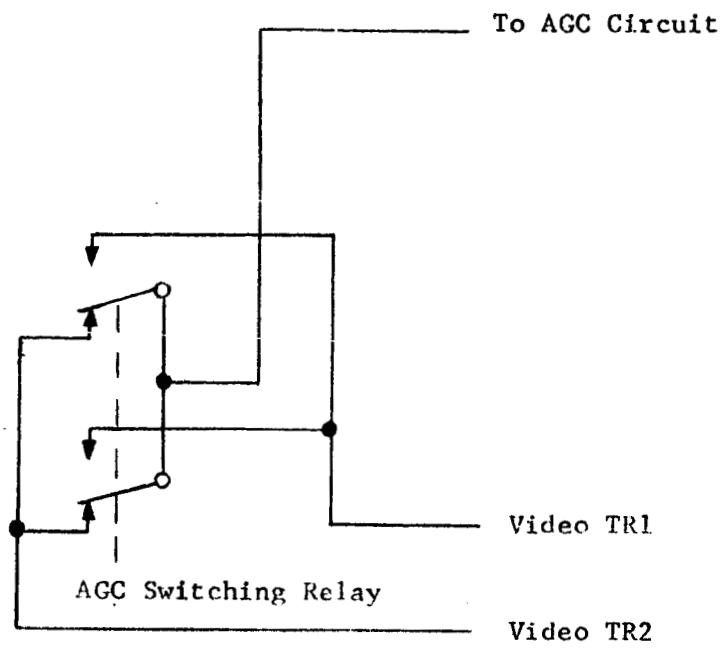


Figure 2.1.3 AGC Switching Relay Diagram

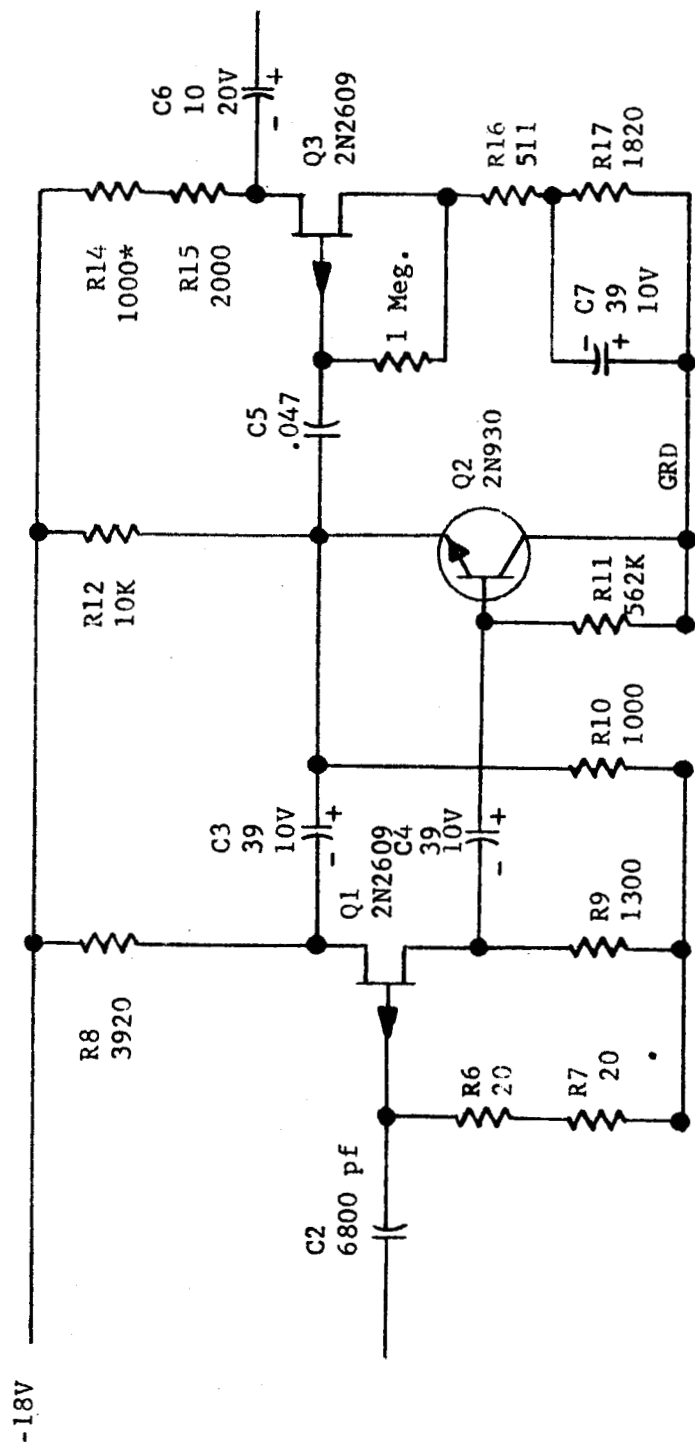
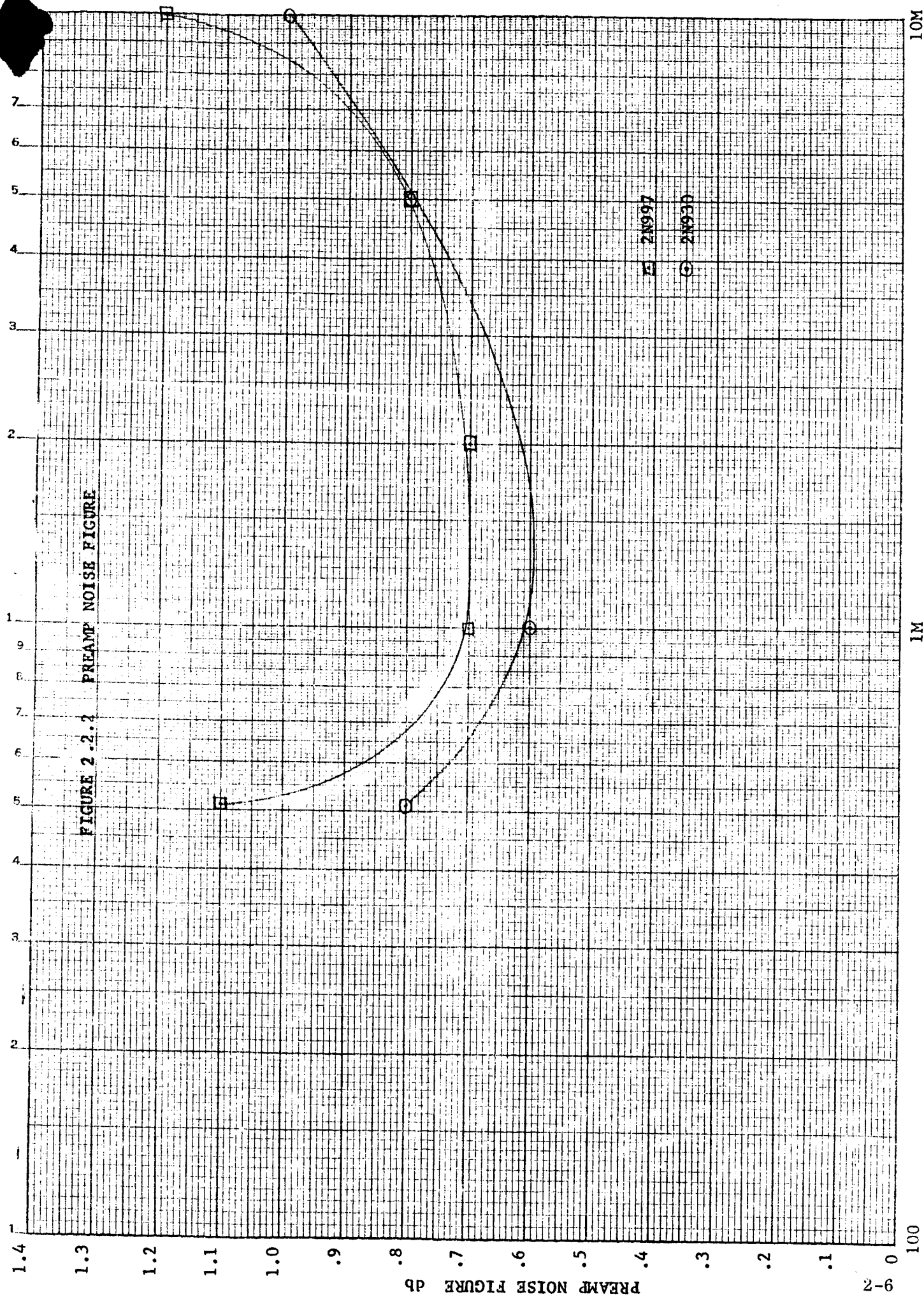


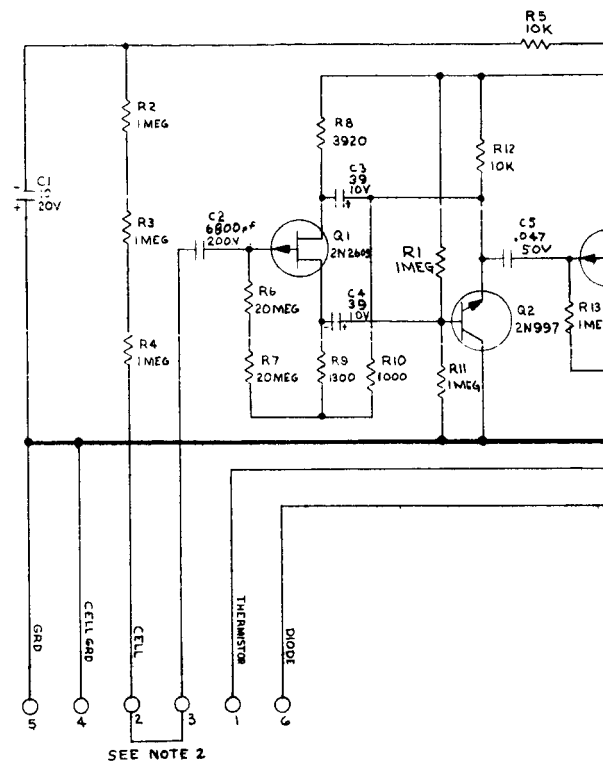
Figure 2.2.1 Old Preamplifier

FIGURE 2.2.2 PREAMP NOISE FIGURE



1M
SOURCE IMPEDANCE - OHMS

10M





3.0 MECHANICAL ENGINEERING

3.1 Scan, Chopper, and Idler Gear Tolerance Deviations

Five sets of the scan gear assembly, chopper gear assembly, and idler gear assembly were received from the New Jersey Gear, Inc. and were inspected on February 15, 1966. Incoming Inspection Reports A-204505, A-204506, A-204507, A-204467, and A204504 indicated that some of the units were out of tolerance. Due to the lead time required to procure new units, we examined the possibility of accepting these units by change notice or rework at our plant.

3.1.1 Scan Gear Assembly

The scan gear assembly is shown in drawing 4708261 and measured dimensions are shown on Inspection Report A-204504. Dimension "J", the retaining ring groove was undersize but could be used by judicious selection of truarc rings. A drawing was made up for these rings to indicate acceptable dimensions. This dimension will be accepted for this job only.

Dimension "C" measured undersize in all units. This will be corrected in our model shop by facing off the threaded section. With the changes made, these units are acceptable.

3.1.2 Chopper Drive Shaft Assembly

The chopper drive shaft assembly, 4708260, was inspected as indicated on Inspection Reports A-204505, and A-204506. Dimensions B, G, and S were out of tolerance. Dimension K was out of tolerance on unit 14 and this unit was used on the engineering model. It was decided that dimension "S" would not affect performance by being slightly undersized. Dimension "G" was accepted on the basis of ECN 183 which changed that dimension to 6.563 ± 0.003 . That ECN also changed dimension "C" to 0.402 ± 0.002 . This change was accomplished by opening up dimension "B" to bring it within tolerance. The shortening of the "C" dimension will cause the mating part, (i.e. the chopper support 4708349), to overlap the retaining ring groove which is necessary for proper operation of the retaining ring.

The danger in allowing dimension "G" to be undersized is that surface "A", shown on the chopper gear assembly (4708326) will not extend beyond the edge of the machined casting. Therefore the procedure for assembly of the chopper gear assembly (4708326) was changed by ECN 185 to add a shim spacer between the duplex bearing and the oil sleeve (see drawing 4708326). Enough shimming is added to cause surface "A" to extend beyond the housing face by at least 0.005 inch (See ECN 185).

3.1.3 Idler Gear Assembly

Five idler gear assemblies, drawing No. 4708262, are described by Inspection Reports A-204507 and A-204467. As a result of this inspection, ECN 176 was written changing dimension 1 from 0.450 to 0.453 and dimension 2 from 0.1880/0.1878 to 0.1885/0.1875. These dimensions were not as critical as the indicated tolerances.

3.2 Detector Cell Mounting

The detector cell assembly is shown in drawing No. 4708256. The wire leads, with teflon sleeving are epoxied to the side of the cell mount. Eastman Kodak was then to cement the detector to the mount and solder the cell wires to the leads. After receiving the units back, it was discovered that through a misunderstanding, Eastman Kodak had not clipped off the leads short enough to allow the cap to fit without shorting the leads. Eastman Kodak agreed to rework the detector mounting and soldering and to shorten the leads so that a good cap fit would be guaranteed. This was done with the loss of one unit in a satisfactory manner.

3.3 Telemetry and Command Changes

The following changes were made to the electronics module bracket (4708429) of the 0/3 module to accommodate the TM and command changes.

1. Removal of six pin RFI filter
2. Addition of command relay
3. Change connector mounting surface caused by changing two 11 pin printed-circuit board connectors to 15 pin connectors.
4. Redesign to accommodate two 35 pin RF filter connectors instead of one.
5. Change the location of the thermistor imbedding point.

Drawing No. 4708375 shows the original design of the bracket.

☒ INCOMING INSPECTION REPORT

No. A-204504

QUANTITY RECEIVED 5	IDM NO.	PURCHASE ORDER 1-38511	DATE INSPECTED 2-15-66	PART NO. 4708261
		RECEIVING TICKET NO.	PROP. NO. 11-18700	DATE REC.
				DESCRIPTION Shaft Assy.

↓ MECHANICAL ↓

ITEM NO.	NO. INSP.	NO. REJ.	BLUE PRINT DIMENSION	PART DIMENSION				
				UNIT	NUMBERS			
				20	21	22	23	24
A			.583 to .593	.5852	.5859	.5849	.5863	.5846
B			.028 to .031	.0295	.0292	.0297	.0302	.0296
C			2.425 to 2.435	2.4168	2.4223	2.4182	2.4216	2.4159
D			2.572 to 2.582	2.5750	2.5750	2.5749	2.5753	2.5748
E			2.634 to 2.644	2.6395	2.6422	2.6405	2.6384	2.6396
F			2.728 to 2.738	2.7329	2.7341	2.7342	2.7314	2.7325
G			3.65 to 3.69	3.6747	3.6710	3.6710	3.6677	3.6723
H			.3122 to .3123	.3122	.3123	.3123	.3123	.3123
I			.302 to .312	.3072	.3071	.3074	.3070	.3071
J			.274 to .278	.272	.273	.273	.273	.273
K			.3122 to .3123	.3123	.3123	.3123	.3123	.3122
L	Chart		.0005	.0004	.0004	.0004	.0005	.0004

↑ ELECTRICAL TEST ↑

PLING PLAN	SINGLE	DOUBLE	MULT.	A. Q. L.	LEVEL	DEFECTS ALLOWED	DEFECTIVES	ACCEPT	REJECT	INSPECTOR	SUP'R.
MECHANICAL	✓			100%						W. France	
ELECTRICAL											

MENTS

AL DISPOSITION	ACCEPT	REJECT	100% INSP.	MRB. NO.	SUPERVISOR
----------------	--------	--------	------------	----------	------------

ITT FORT WAYNE



QUANTITY RECEIVED 5		IBM NO.	PURCHASE ORDER 1-38511	RECEIVING TICKET NO.	DATE INSPECTED 2-15-66	PROP. NO. 11-18700	PART NO. 4708260	DATE REC.	DESCRIPTION Chopper Drive shaft
------------------------	--	---------	---------------------------	----------------------	---------------------------	-----------------------	---------------------	-----------	------------------------------------

↓ MECHANICAL ↓

ITEM NO.	NO. INSP.	NO. REJ.	BLUE PRINT DIMENSION	PART DIMENSION				
				UNIT NUMBERS				
				10	11	12	13	14
A			.026 to .036 ^{OK}	.0346	.0366	.0357	.0344	.0344
B			.040 to .043 ^{NO}	.0376	.0365	.0373	.0381	.0366
C			.401 to .406 ^{OK}	.4055	.4042	.4043	.4047	.406
D			.898 to .908 ^{OK}	.9004	.8998	.9008	.8992	.9002
E			1.035 to 1.045 ^{OK}	1.0375	1.0379	1.0376	1.0349	1.0374
F			5.522 to 5.532 ^{OK}	5.5242	5.5254	5.5268	5.5260	5.5233
G			6.567 to 6.572 ^{NO}	6.5629	6.5648	6.5648	6.5647	6.5632
H			7.035 to 7.045 ^{OK}	7.0385	7.0388	7.0408	7.0362	7.0390
I			7.222 to 7.232 ^{OK}	7.2265	7.2274	7.2287	7.2281	7.2292
J			7.792 to 7.802 ^{OK}	7.7965	7.7977	7.7971	7.7985	7.7990
K			.3124 to .3125 [?]	.3124	.3124	.3124	.3124	.3123
L			.274 to .278 ^{OK}	.275	.275	.274	.276	.275
M			.302 to .312 ^{OK}	.3065	.307	.3073	.3065	.3066
N			.3122 to .3123 ^{OK}	.3122	.3123	.3122	.3123	.3122

Page 1 of 2

↑ ELECTRICAL TEST ↑

SAMPLING PLAN	SINGLE	DOUBLE	MULT.	A. Q. L.	LEVEL	DEFECTS ALLOWED	DEFECTIVES	ACCEPT	REJECT	INSPECTOR	SUP'R.
ELECTRICAL										D. Frame	

SERIAL DISPOSITION	ACCEPT	REJECT	100% INSP.	MRB. NO.	SUPERVISOR
--------------------	--------	--------	------------	----------	------------



INCOMING INSPECTION REPORT

No. A-204506

QUANTITY RECEIVED 5	ITEM NO.	PURCHASE ORDER 1-38511	DATE INSPECTED 2-15-66	PART NO. 4708 260
		RECEIVING TICKET NO.	PROP. NO. 11-18700	DATE REC.
		DESCRIPTION Chrysler Drive Shaft		

↓ MECHANICAL ↓

M. N.	NO. INSP.	NO. REJ.	BLUE PRINT DIMENSION	PART DIMENSION				
				10	11	12	13	14
			.028 to .031 OK	.0288	.0287	.0282	.0278	.0288
			.028 to .031 OK	.0275	.0276	.0275	.0276	.0275
			.028 to .031 OK	.0275	.0275	.0275	.0276	.0275
			.028 to .031	.0275	.0274	.0274	.0276	.0275
			.23 to .27 OK	.26	.259	.261	.261	.261
			.2811 to .2812 OK	.2812	.2811	.2811	.2811	.2811
1			Chart .0005	.0002	.0004	.0002	.0002	.0003

No markings on any of the units.

↑ ELECTRICAL TEST ↑

PLING PLAN MECHANICAL	SINGLE	DOUBLE	MULT.	A. Q. L.	LEVEL	DEFECTS ALLOWED	DEFECTIVES	ACCEPT	REJECT	INSPECTOR W. Frame JR	SUP'R.
ELECTRICAL											

MENTS

ECN 178 states that these five units will be hand marked at ITTIL.

INCOMING INSPECTION REPORT

No. A-204507

PURCHASE ORDER 1-25571		DATE INSPECTED 2/24/66	PART NO. 4708262
CITY RECEIVED 1	IBM NO.	RECEIVING TICKET NO. 11-18700	DATE REC.
			DESCRIPTION 11th Gear

↓ MECHANICAL ↓

[illegible]

↑ ELECTRICAL TEST ↑

[illegible]

COMMENTS

SERIAL DISPOSITION	ACCEPT	REJECT	100% INSP.	MRB. NO.	SUPERVISOR
--------------------	--------	--------	------------	----------	------------

ITT FORT WAYNE

3-6

REQUEST FOR COMPONENT APPROVAL

☒ INCOMING INSPECTION REPORT

No. A-204467

NDOR <i>N. J. Gear & MFG Co.</i>	PURCHASE ORDER	DATE INSPECTED <i>2-9-66</i>	PART NO. <i>AS INDICATED</i>
QUANTITY RECEIVED <i>4 Pcs.</i>	IBM NO.	RECEIVING TICKET NO.	PROP. NO. <i>11-18700</i>
		DATE REC.	DESCRIPTION <i>Gear Cluster</i>

↓ MECHANICAL ↓

4708262

ITEM NO.	NO. INSP.	NO. REJ.	BLUE PRINT DIMENSION	PART DIMENSION
33			#1 = .450 #2 = .1880 <i>.1878</i> #3 = .12470 <i>.12470</i>	#1 = (.4557) #2 = (.1877) #3 = .12470
			#4 = .278 #5 = .309 #6 = .495	#4 = .279 #5 = .310 #6 = .493
			#7 = .125 #8 = .745	#7 = .124 #8 = .746
32				#1 = (.4558) #2 = (.1885) #3 = .12470
				#4 = .278 <i>.2785</i> #5 = .3085 #6 = .4925
				#7 = .124 #8 = .746
31				#1 = (.4554) #2 = (.1881) #3 = .12470
				#4 = .2785 #5 = .3091 #6 = .493
				#7 = .123 #8 = .747
34				#1 = (.4558) #2 = (.1877) #3 = .12470
				#4 = .278 #5 = .3084 #6 = .494
				#7 = .1245 #8 = .747

↑ ELECTRICAL TEST ↑

SAMPLING PLAN MECHANICAL	SINGLE	DOUBLE	MULT.	A. Q. L. <i>100%</i>	LEVEL	DEFECTS ALLOWED <i>0</i>	DEFECTIVES	ACCEPT	REJECT	INSPECTOR <i>[Signature]</i>	SUP'R.
ELECTRICAL											

COMMENTS
Parts accepted per ERN 176 and print 4708262
Rev A.

MATERIAL DISPOSITION <i>Send to stock</i>	ACCEPT <i>4</i>	REJECT	100% INSP. <i>✓</i>	MRB. NO.	SUPERVISOR <i>[Signature]</i>
--	--------------------	--------	------------------------	----------	----------------------------------

ITT FORT WAYNE

ENGINEERING CHANGE ORDER				C.O.NO. <u>176</u>	
ITT INDUSTRIAL LABORATORIES				SHT <u>1</u> OF <u>1</u>	
ORIGIN		UNIT OR ASSY	DRAWINGS AFFECTED		EFFECTIVITY
ENG	✓	SHAFT ASSY, IDLER GEAR	C4708262		MOD
PROD					S/N
SERV					RETROFIT

REVISE DOCUMENTATION AND MANUFACTURING PROCESSES AS FOLLOWS

IN ZONE B3: CHANGE .450 DIM TO; .453

IN ZONE C3: CHANGE $\frac{.1880}{.1878}$ DIM. TO; $\frac{.1885}{.1875}$

IN SPECIFICATIONS: ADD AFTER MAKING
NOTE.

"GEAR ASSEMBLY TO BE PRECISION
CLASS 3."

REASON FOR CHANGE :

ENGINEERING CHANGE

SIGNATURES		DATE	INVENTORY & DISPO- SITION OF PARTS	DISPOSITION		
				USE	R'WK	SCRAP
ORIGINATOR	<i>H. Schaff</i>	FEB 11, 1966	WORK IN PROCESS	✓		
APPROVAL	<i>H. Schaff</i>	2/11/66	INVENTORY			
CHANGED BY	<i>H. Schaff</i>	FEB 11, 1966	UNITS IN TEST			
CHECKED BY	<i>G. Mitchell</i>	FEB 11, 1966	UNITS IN FIELD			

ENGINEERING CHANGE ORDER				C.O. NO. <u>183</u>	
ITT INDUSTRIAL LABORATORIES				SHT <u>1</u> OF <u>1</u>	
ORIGIN		UNIT OR ASSY	DRAWINGS AFFECTED		EFFECTIVITY
ENG	<input checked="" type="checkbox"/>	SHAFT ASSY CHOPPER DRIVE	C 4708260		MOD
PROD	<input type="checkbox"/>				S/N
SERV	<input type="checkbox"/>				RETROFIT

REVISE DOCUMENTATION AND MANUFACTURING PROCESSES AS FOLLOWS

1. ZONE C-4, CHANGE .406 $\begin{smallmatrix} +.000 \\ -.005 \end{smallmatrix}$ TO: .402 $\begin{smallmatrix} +.002 \\ -.001 \end{smallmatrix}$
 2. ZONE B-3, CHANGE 6.567 $\begin{smallmatrix} +.005 \\ -.000 \end{smallmatrix}$ TO: 6.563 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$
 3. THE DISCREPANCY NOTED ON INCOMING INSPECTION REPORT No. A-204505, ITEM No. K PART No. 4708260-14 IS TO BE ACCEPTED & USED ON THE ENGINEERING MODEL ONLY.
 4. THE DISCREPANCIES NOTED ON INCOMING INSPECTION REPORT No. A-204506, ITEM No. S, PART No's 4708260-10, -11, -12, -13 & -14 ONLY ARE TO BE ACCEPTED WITH A DIMENSION OF .028 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$.
- * NOTE REWORK REQUIRED ON CHANGE NO. 1 ONLY.

REASON FOR CHANGE

ENGINEERING CHANGE

SIGNATURES		DATE	INVENTORY & DISPOSITION OF PARTS	DISPOSITION		
ORIGINATOR	<i>H. Schell</i>	2 MAR 66		USE	R'WK	SCRAP
APPROVAL	<i>[Signature]</i>	3 MAR 66	WORK IN PROCESS		*✓	
			INVENTORY		*✓	
CHANGED BY	<i>H. Schell</i>	3 MAR 66	UNITS IN TEST			
CHECKED BY	<i>D. Mitchell</i>	3/3/66	UNITS IN FIELD			

ENGINEERING CHANGE ORDER			C.O.NO. <u>184</u>
ITT INDUSTRIAL LABORATORIES			SHT <u>1</u> OF <u>1</u>
ORIGIN	UNIT OR ASSY	DRAWINGS AFFECTED	EFFECTIVITY
ENG	✓ SHAFT ASSY. SCAN DRIVE	C4708261	MOD
PROD			S/N
SEIV			RETROFIT

REVISE DOCUMENTATION AND MANUFACTURING PROCESSES AS FOLLOWS

1. ZONE C-2, CHANGE $1.880^{+.0000}_{-.0002}$ TO: $1.880^{+.0000}_{-.0002}$ ✓

2. THE DISCREPANCIES NOTED ON INCOMING INSPECTION REPORT No. A-204504 ITEM No. "J", PART No's 4708261-20, -21, -22 -23 & -24 ONLY ARE TO BE ACCEPTED WITH A DIMENSION OF $.274 \pm .002$

3. THE DISCREPANCIES NOTED ON INCOMING INSPECTION REPORT No. A-204504, ITEM No. "C", PART No's 4708261-20, -21, -22, -23 & -24 ONLY ARE TO BE REWORKED TO THE DIMENSION ON THE DWG 2.430

* NOTE REWORK REQUIRED ON CHANGE NO 3 ONLY.

REASON FOR CHANGE

ENGINEERING CHANGE

SIGNATURES	DATE	INVENTORY & DISPOSITION OF PARTS	DISPOSITION		
ORIGINATOR <i>H. Smith</i>	2 MAR 66		USE	R'WK	SCRAP
APPROVAL <i>J. Y. Smith</i>	3 Mar 66	WORK IN PROCESS		* ✓	
		INVENTORY		* ✓	
CHANGED BY <i>H. Smith</i>	3 MAR 66	UNITS IN TEST			
CHECKED BY <i>G. M. Smith</i>	3/3/66	UNITS IN FIELD			

ENGINEERING CHANGE ORDER				C.O.NO. <u>185</u>	
ITT INDUSTRIAL LABORATORIES				SHT <u>1</u> OF <u>1</u>	
ORIGIN		UNIT OR ASSY	DRAWINGS AFFECTED		EFFECTIVITY
ENG	<input checked="" type="checkbox"/>	ASSEMBLY	A4708325		MOD
PRCD	<input type="checkbox"/>	PROCEDURE			S/N
SERV	<input type="checkbox"/>	SPEC FOR C4708326 CHOPPER GEAR ASSY			RETROFIT

REVISE DOCUMENTATION AND MANUFACTURING PROCESSES AS FOLLOWS

1. CHANGE NOTE 5 TO: INSTALL ITEM 6 ONTO ITEM 1, TIGHTEN ITEM 3 ONTO THE DUPLEX BEARING WITH SUFFICIENT TORQUE TO REMOVE ANY PLAY BETWEEN THE DUPLEX BEARING PAIR.
2. ADD NEW NOTE 6: INSERT ASSEMBLY INTO RADIOMETER HOUSING ASSY 4708398 AND CHECK EXTENSION OF SURFACE "A" FROM FACE OF HOUSING. THERE MUST BE A MINIMUM OF .005 EXTENDING BEYOND HOUSING FACE. IF SURFACE "A" DOES NOT EXTEND BEYOND HOUSING FACE .005, REMOVE ASSEMBLY FROM HOUSING AND LOOSEN ITEM 3, REMOVE ITEM 6 AND INSTALL ITEM 9 AS REQUIRED AGAINST INTER FACE OF ITEM 2 TO INSURE A .005 EXTENSION, INSTALL ITEM 6.
3. CHANGE NOTE 6 TO NOTE 7; NOTE 7 TO 8; NOTE 8 TO 9 AND IN NOTE 9 CHANGE 6 TO 7 & 7 TO 8; CHANGE NOTE 9 TO 10; NOTE 10 TO 11; NOTE 11 TO 12

REASON FOR CHANGE

ENGINEERING CHANGE

SIGNATURES	DATE	INVENTORY & DISPOSITION OF PARTS	DISPOSITION		
			USE	R'WK	SCRAP
ORIGINATOR <i>K. Schaff</i>	1 APRIL 66	WORK IN PROCESS	<input checked="" type="checkbox"/>		
APPROVAL <i>J. Williams</i>	4 April 66	INVENTORY			
CHANGED BY <i>K. Schaff</i>	1 APRIL 66	UNITS IN TEST			
CHECKED BY <i>Smith</i>	APR/4/66	UNITS IN FIELD			

1. Install item 4 into item 3.
2. Install item 3 onto item 1 and tighten finger tight.
3. Install item 7 onto item 1.
4. Open a set of duplex bearings item 2 (check to verify that they are marked back to back with an open chevron on the outer race of each bearing) and install them with the open chevron facing each other onto item 1.
5. Install item 6 onto item 1, tighten item 3 onto the duplex bearing with sufficient torque to remove any play between the duplex bearing pair.
6. Insert assembly into radiometer housing, assy. 4708398, and check extension of surface "A" from face of housing. There must be a minimum of .005 extending beyond the housing face. If surface "A" does not extend beyond housing face .005, remove assembly from housing and loosen item 3, remove item 6 and install item 9 as required against inter race of item 2 to insure a .005 extension, install item 6.
7. Install item 5 onto item 1 and push up against item 6. (Item 5 may break during assembly so care must be exercised.)
8. Install item 6 next to item 5 onto item 1.
9. Install item 6 onto item 1 and repeat notes 7 and 8.
10. Tighten item 3 onto the duplex bearing with sufficient torque to remove any play between the duplex bearing pair.
11. Tighten item 4 into item 3 with an allen wrench and set item 4 into item 3 by using a small punch and hammer. Protect the gear teeth during this operation.
12. Store the assembly to protect it from dust and moisture.

QTY	ITEM	DWD SIZE	PART NUMBER	DESCRIPTION														
			INDUSTRIAL LABORATORIES <small>A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION</small> 3700 PONTIAC ST. FORT WAYNE, IND.															
TOLERANCES UNLESS OTHERWISE SPECIFIED <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">BASIC DIM</th> <th style="width: 15%;">2 PLACE</th> <th style="width: 15%;">3 PLACE</th> <th style="width: 15%;">ANGLES</th> </tr> <tr> <td>UNDER 6</td> <td>± .02</td> <td>± .005</td> <td rowspan="3" style="text-align: center; vertical-align: middle;">± 1/8°</td> </tr> <tr> <td>6 TO 24 INCL</td> <td>± .03</td> <td>± .010</td> </tr> <tr> <td>TO 72 INCL</td> <td>± .06</td> <td>± .020</td> </tr> </table>			BASIC DIM	2 PLACE	3 PLACE	ANGLES	UNDER 6	± .02	± .005	± 1/8°	6 TO 24 INCL	± .03	± .010	TO 72 INCL	± .06	± .020	Assembly Procedure and Spec. for C4708326 Chopper Gear Assembly. <div style="display: flex; justify-content: space-between;"> <div> DRAWN BY <i>ET/4465</i> DATE <i>11-18772</i> <i>J.L. AMSDEN</i> APPD. <i>7 SEPT 65</i> DATE <i>P. SARGENT</i> APPD. <i>16 SEPT 65</i> DATE <i>W. WALLSCHLAGER</i> </div> <div> USED ON <i>11-18772</i> NEXT ASSY <i>C 4708326</i> LAST REV. NO. <i>A</i> </div> </div>	
BASIC DIM	2 PLACE	3 PLACE	ANGLES															
UNDER 6	± .02	± .005	± 1/8°															
6 TO 24 INCL	± .03	± .010																
TO 72 INCL	± .06	± .020																
			A	470 8325														
COMMERCIAL TOLERANCES APPLY TO STOCK SIZES			SHEET 3-12															

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 OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT PERMISSION.

470 8325

A

SCALE 2:1	DRAWING SHEET	NUMBER

SPECIFICATIONS:

SINUSOIDAL VIBRATION:
 5-200 CPS; 15g - PEAK, 1/3 SINGLE AMPLITUDE
 200-2000 CPS; 10g - PEAK
 ONE OCTAVE PER MINUTE IN EACH OF THREE
 ORTHOGONAL DIRECTION.

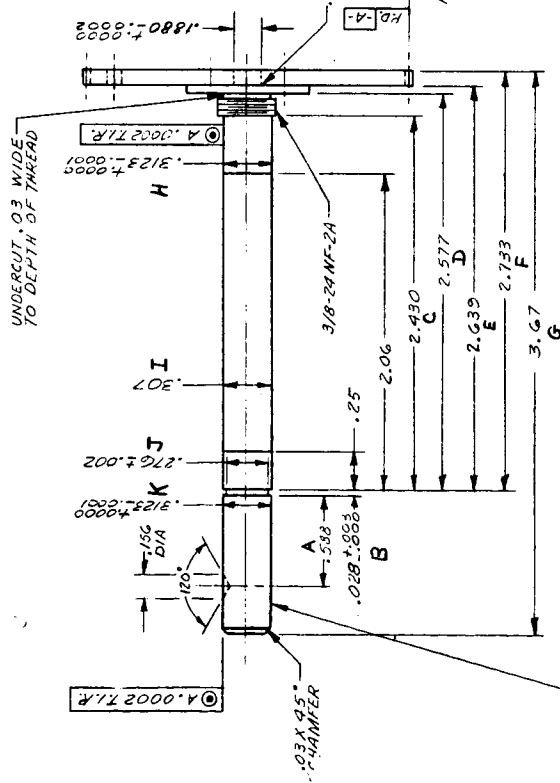
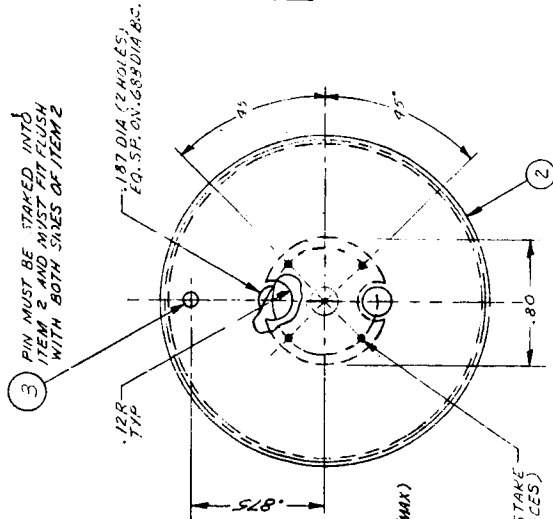
RANDOM VIBRATION: 0.2g - 1/10 RMS
 20-2000 CPS; 0.2g - 1/10 RMS
 4 MINUTES IN EACH OF THREE ORTHOGONAL
 DIRECTIONS.

ACCELERATION:
 30g FOR 5 MINUTES IN THE DIRECTION
 PERPENDICULAR TO THE SHAFT AXIS.

BLUE TAPE CHART: L
 BLUE TAPE CHART SHALL BE PROVIDED
 WITH EACH ASSEMBLY.

MARKING:
 EACH GEAR ASSEMBLY SHALL BE APPROXIMATELY
 STAMPED OR MARKED IN A PERMANENT FASHION
 WITH A SERIAL NUMBER STARTING WITH 20.
 THE CORRESPONDING BLUE TAPE CHART WILL BE
 IDENTIFIED WITH THE GEAR ASSEMBLY SERIAL
 NUMBER.

NOTE:
 (C) INDICATES CONCENTRICITY



1. MATERIAL: STAINLESS STEEL
 FINISH: PASSIVATE

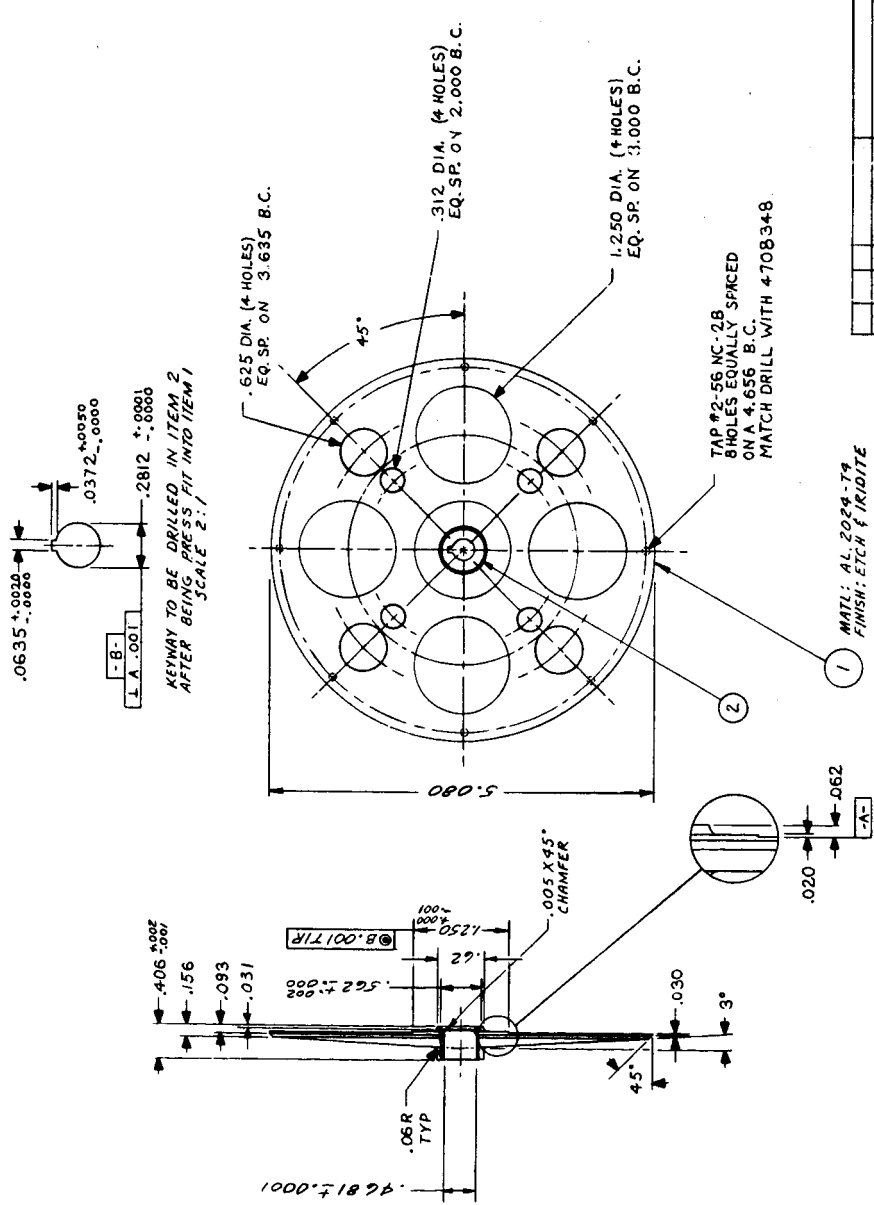
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QTY	ITEM	PART NUMBER	DESCRIPTION
1	3		PIN .033 DIA X .073 LG, DRILL ROD
1	2	4708261-2	SPUR GEAR
1	1	C THIS DWG-1	SHAFT

INDUSTRIAL LABORATORIES FORT WAYNE, IND. A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION	
DATE: 1/1/60 DRAWN BY: J. H. HARRIS CHECKED BY: J. H. HARRIS APPROVED BY: J. H. HARRIS	SCALE: 2:1 SHEET: 1 OF 1 C 4708261/A

11

REVISIONS			
REV	DATE	BY	CHK
A	1/1/57		
ADDED: DIM IN LEFT SIDE VIEW X 75° CHAMFER. ITEMS 1, 2 & ASSOCIATED CALLOUTS. NOTATION: KEYWAY TO BE DRILLED WAS ENLARGED VIEW OF ACTUAL DIMENSION WAS 1.250 DIA. ON 3.000 B.C.			
B	1/1/57		
ADDED: DIM IN LEFT SIDE VIEW WAS 1.250 DIA. ON 3.000 B.C.			

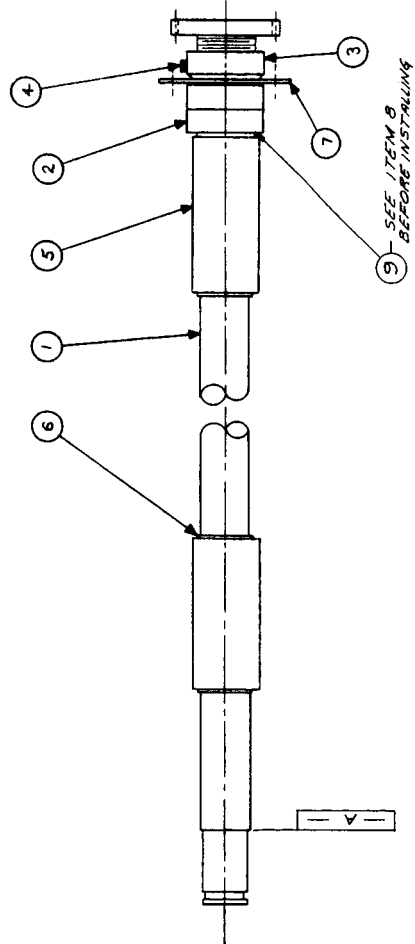
4708349



LIST OF MATERIAL			
QTY	ITEM	PART NUMBER	DESCRIPTION
1	2	4708423	INSERT, CHOPPER SUPPORT
1	1	THIS DING-1	CHOPPER SUPPORT
TIT INDUSTRIAL LABORATORIES FORT WAYNE, IND. A DIVISION OF INTERNATIONAL BUSINESS AND TRADE CORPORATION			
CHOPPER SUPPORT			
SCALE: 1/1			
4708349			
SHEET			

4708326 A

REVISIONS	
1	ADDED ITEM 9 & SURFACE



4708326 A

REF	QTY	ITEM	DESCRIPTION
1	1	4708326	SPACER SHIM
2	1	4708325	ASSY PROCEDURE & SPECIFICATION
3	1	4708327	RING BEARING RETAINER
4	1	4708328	RETAINING RING (WALDES KOHNOOR-5103-31)
5	1	4708329	SLEEVE OIL IMPREGNATED
6	1	4708330	SCR SET, MET 506, CUP PT, CRES (C/NICKED) 302
7	1	4708331	NUT BEARING RETAINER
8	1	4708332	BEARING, DUPLEX
9	1	4708333	SHAFT ASSY, CHOPPER DRIVE

SIGNATURE & DATE	
DATE: 11/18/72	
BY: [Signature]	
TITLE: [Title]	
SCALE: 2/1	
SHEET: 1	

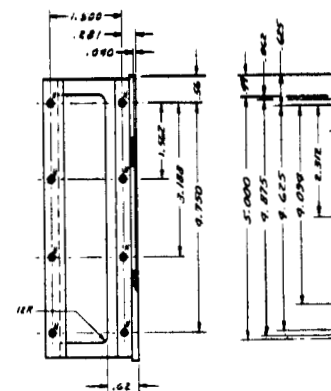
UNLESS OTHERWISE SPECIFIED	
DIMENSIONS ARE IN INCHES AND DECIMALS THEREOF	
TOLERANCES	
FRACTIONS	
DECIMALS	
FINISH	
APPLICATION	

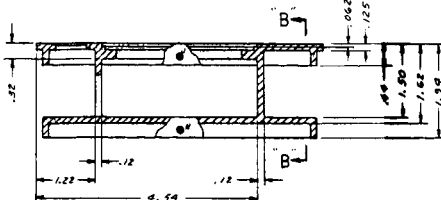
MATERIAL	
INDUSTRIAL LABORATORIES FORT WAYNE, IND.	
A DIVISION OF INTERNATIONAL BUSINESS MACHINES CORPORATION	
CHOPPER GEAR ASSY.	
4708326 A	

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIMS TO BE .000.

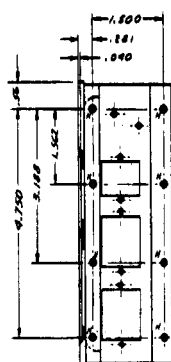
ALL DIMS TO BE .000
UNLESS OTHERWISE SPECIFIED
1. ALL DIMS TO BE .000

SYM	DESCRIPTION	UNIT
A	1/2" DIA	"
B	1/4" DIA	"
C	1/8" DIA	"
D	1/16" DIA	"
E	1/32" DIA	"
F	1/64" DIA	"
G	1/128" DIA	"
H	1/256" DIA	"
I	1/512" DIA	"
J	1/1024" DIA	"
K	1/2048" DIA	"
L	1/4096" DIA	"
M	1/8192" DIA	"
N	1/16384" DIA	"
O	1/32768" DIA	"
P	1/65536" DIA	"
Q	1/131072" DIA	"
R	1/262144" DIA	"
S	1/524288" DIA	"
T	1/1048576" DIA	"
U	1/2097152" DIA	"
V	1/4194304" DIA	"
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FG	1/51422018003116572492550302791047824440838333368631296" DIA	"
FG	1/102844036006233144970100605582095648816676666737262592" DIA	"
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FG	1/822752288049865159760804844656765190533413333898100736" DIA	"
FG	1/1645504576099730319521609689313530381066826667796201472" DIA	"
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FG	1/2632807321759568511234575102901648609706922664473922352" DIA	"
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FG	1/21062458574076548089876600823213188877655381315791378816" DIA	"
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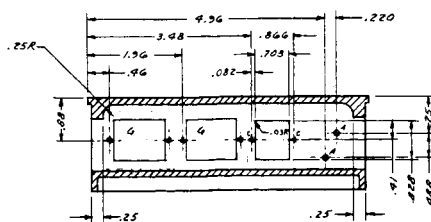


SECTION 'A-A'



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RADII TO BE .06R.

SYM	DESCRIPTION	REQ
A	.125 DIA	2
B	.149 DIA	2
C	W-.90 UNC-18	18
D	SEE FIG 1	1A
E	SEE FIG 2	16A
F	SEE FIG 3	16A
G	SEE FIG 4	20A
H	#1030-CO10 HELI-COIL INSERTS INSTALLED PER MSL2388-100 CLASS #8 TND WITH CSR HOLE, REMOVE RING	28
J	#1030-CO30 HELI-COIL INSERTS INSTALLED PER MSL2388-100 CLASS #8 TND WITH CSR HOLE, REMOVE RING	6
K	#1030-CO50 HELI-COIL INSERTS INSTALLED PER MSL2388-100 CLASS #8 TND WITH CSR HOLE, REMOVE RING	8



SECTION 'B-B'

[illegible]

4708375

H 470837

4.0 OPTICAL ENGINEERING

4.1 Optical Filter Transmission

The spectral transmission curves of the SWBP (short wave bandpass) filter, i. e. the "daytime" section which transmits between 0.70 and 1.3 microns, which was measured by Optical Coating Lab., Inc. (OCLI) did not indicate what the transmission was beyond 2.5 microns. It was understood (via phone contacts with OCLI) and clearly stated in our purchase specifications that the SWBP section should have minimum transmission between 1.3 and 5.5 microns (the choice of glass substrate was left up to OCLI to select on the basis of coating adherence, temperature cycling, stability of coatings with time, etc.). OCLI indicated that a "sideband" transmission band with about one-fifth the transmission would occur near 2.5 microns but the glass substrate would cut off all transmission beyond 3 microns (this sideband does not cause any problem). Actual measurements on the SWBP filters showed however that there was considerable transmission (about 15 percent) out to 4 microns and then dropping to almost zero at about 4.5 microns. Since this could not be tolerated, all of the filters were returned to the manufacturer. They bonded an annular section of Type OW-1 glass (mfg. by Fish-Schurman) of 0.040 inch thickness onto the uncoated side of the SWBP filter. This type glass will effectively eliminate all transmission beyond 3.0 microns (this glass was not used as the substrate material because the coatings applied to it tend to "craze" according to OCLI). American Optical Type AO-805 cement was used to make this bond because of its good shock and temperature stability characteristics. The SWBP filters were made in two different batches (evaporations) and have slightly different characteristics. The spectral transmission of test samples from each of these batches are shown on the following pages. The effect of adding OW-1 glass is also shown on another curve. All of the filter elements for the 3.4 to 4.2 micron bandpass were made in one evaporation (OCLI Batch No. 1213-31-1) and are all very much identical in spectral transmission characteristics. The transmission curve for one of the filters is included on one of the following pages and cutoff characteristics for the different filters are given in Table 4.1.

The two-color optical filters received from OCLI were visually inspected using a Bausch and Lomb Zoom Stereomicroscope. Slight imperfections were observed on a few of the filters but the defect area is small enough that the imperfections can be tolerated. These imperfections were of two types (1) small bubbles in the bonding cement used to glue the OW-1 glass to the SWBP filter (0.70-1.30 micron) section and (2) small pin hole size pits on the surface coating of the LWBP filter (3.4-4.2 micron) section. The better quality filters will be reserved for the flight models.

Table 4.1 Cutoff Characteristics of 3.4 to 4.2 Micron Filters

Part No.	Half-Peak Transmission Wavelength		Five Percent Transmission Wavelength	
	Lower Cutoff	Upper Cutoff	Lower Cutoff	Upper Cutoff
1	3.60 microns	4.03 microns	3.36 microns	4.15 microns
2	3.48	4.03	3.36	4.15
3	3.50	4.06	3.38	4.18
4	3.48	4.04	3.37	4.16
5	3.45	4.00	3.34	4.12
6	3.51	4.07	3.39	4.19

4.2 Scan Mirror Flatness

Tests for flatness of optical components are commonly conducted by plating the surface to be tested in contact with an optical flat whose flatness is known and is flatter than the surface to be tested. In the past the Nimbus radiometer mirrors were checked in this manner, however, two problems were encountered. First, the weight of the optical flat or the pressure applied to the scan mirror to keep the surfaces in contact caused the scan mirror to distort from its true shape (the shape and number of light interference fringes are observed during these tests). Second, the scan mirror could not be tested when mounted on its carriage using this technique, hence any bending caused by mounting the mirror could not be ascertained.

The test setup devised for incoming inspection tests is shown in Figure 4.5. The radiometer scan mirror is mounted on its carriage and mounted in the main radiometer casting just as it is in the final increment. One of the telescopes whose properties have already been measured is also mounted in the casting as shown. With the chopper wheel removed, a small glass disc with one side finely ground to diffuse the light, is placed in the focal plane of the telescope and an image formed on the diffusing side (the diffuser is required because the secondary mirror of the telescope blocks the central part of the cone of light; no light would enter the observing microscope if the diffuser were not used). The light source for the test is a long focal length collimator (Newtonian-type telescope with 76 inch focal length) and a zirconium arc lamp with 0.005 inch diameter - the angular spread of the light beam is 0.066 milliradian which is considerably smaller than the resolution of the optical elements under test. The collimator can be thought of as a "point" source or star simulator.

The radiometer telescope forms an image of this light on the glass diffuser which would have a diameter of 0.26 mils (thousandths of an inch) if the scan mirror and telescope were perfect. The actual size of the light spot is measured by observing it with a Bausch and Lomb 40X microscope with a calibrated reticle.

Telescope serial number 370-1 was used for all of the flatness tests. When the light spot was formed by this telescope alone (i. e. in a manner similar to that above except without reflecting the light at right angles by the scan mirror), the light spot was nearly circular with a diameter of 0.004 inch (a small hump on one side increased the diameter to 0.006 inch in that direction). As long as the light spot diameter of the telescope only does not exceed 0.007 inch it is acceptable. The light spot diameter of the scan mirror-telescope combination should not exceed 0.011 inch (this is about one-fourth the width of the chopper openings which are 0.0456 inch).

Initial measurements showed that very elongated, elliptical or figure-eight form images were obtained with some of the scan mirrors, some of the images being as long as 0.040 inch but only 0.006 inch wide. It was observed that the elongation occurred in the same plane as the major axis of the elliptical scan mirror and that the mirror carriage had locating flanges in this same plane. Independent tests with unmounted scan mirrors indicated that the difficulty was not due to the scan mirror itself but was introduced in the mounting procedure. Micrometer measurements disclosed that some of the mirror carriages were out-of-tolerance and that some of the scan mirrors had to be forced on to their carriages. This interference was relieved on one of the scan mirror assemblies and was then retested. With the mounting screws just snug, the light spot image was within tolerance. The screws were then tightened in steps and retested each time until a torque of 48 in-oz, was applied. Tightening of the screws to this torque setting, which should be completely safe to withstand vibration, did not noticeably affect the size or shape of the light spot. (On Nimbus I and II radiometers, carriages were hand selected which fit easily into the scan mirror, hence, this effect should not have been present to any great extent in previous instruments.) Five different scan mirrors were mounted in turn on the one modified carriage and light spot images ranging from a minimum diameter of 0.008 inch (nearly circular image) to a maximum spot size of 0.004 inch by 0.013 inch (elliptical shaped image were observed). It is clear that all of the mirror carriages would have to be remachined so that the scan mirrors fit on their respective carriages easily (i. e. without having to be forced on) and then retested.

4.3 Telescopes

Six Bausch and Lomb 4 inch, f/1 telescopes were serialized and tested for resolution characteristics using the "point" source collimator and calibrated microscope described above. These tests were conducted on an optical bench (rather than being mounted in the radiometer casting) and the light was not reflected off the scan mirror so that the resolution of the telescopes themselves could be measured.

The light spot image (on the optical axis) was very nearly circular in shape for all six telescopes and ranged in diameter from 0.003 to 0.006 inch. Thus, all of these telescopes are suitable in this respect for use in the HRIR.

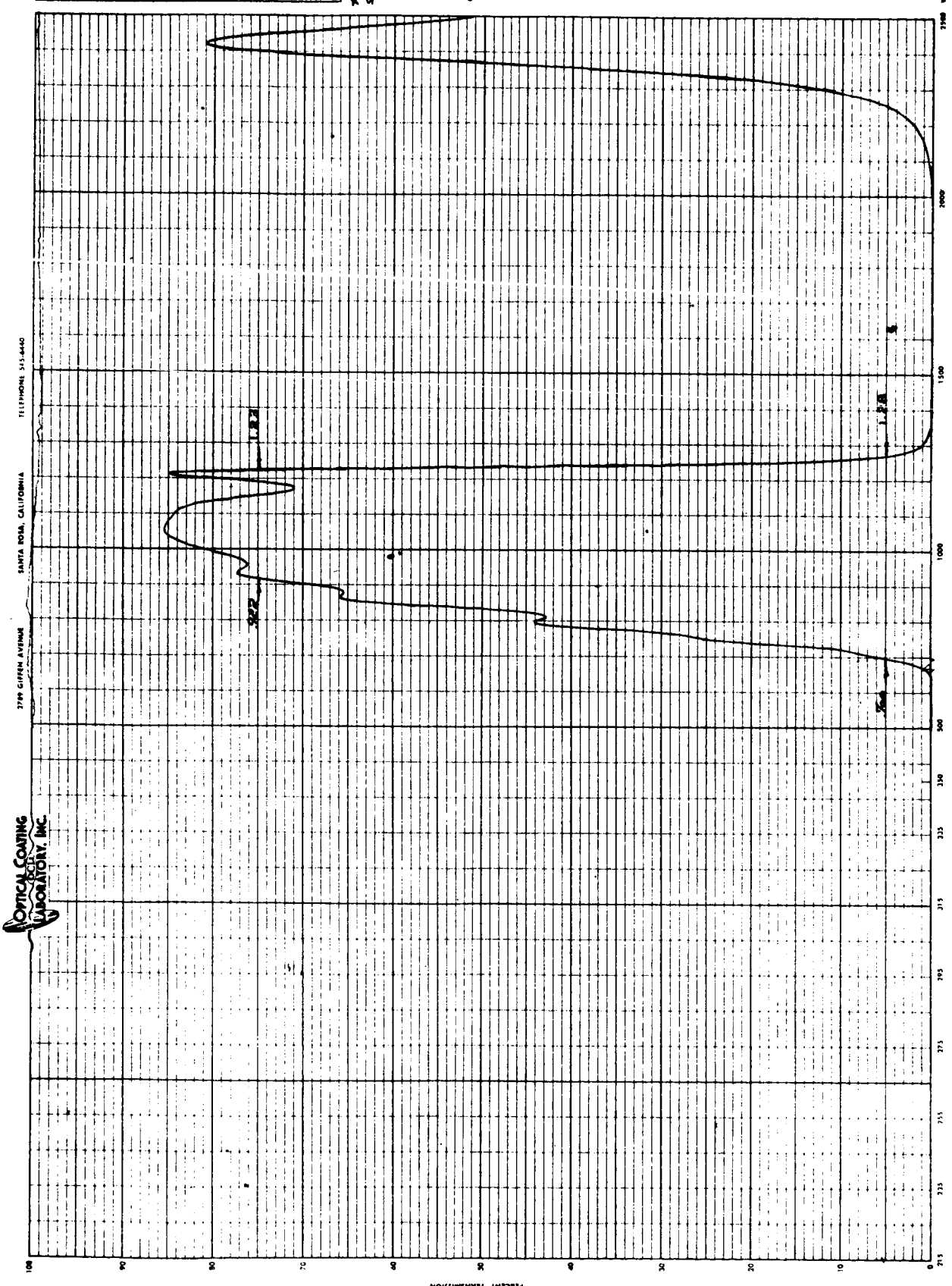
637b
OCL: 14

DK-2 SCAN	
OCLI W/O 12-4657-89	
Batch 7223-412	
Filter Type WBP	
Substrate Glass	
Substrate Size 10.1 x 8.0	
Scan Speed 1 x 30	
Response .1	
Incident Angle 0°	
Item 1	
Analyst	Eni
Date	12/1/65

Approved
SCAN OF WITNESS
PART.

without OW-1 glass

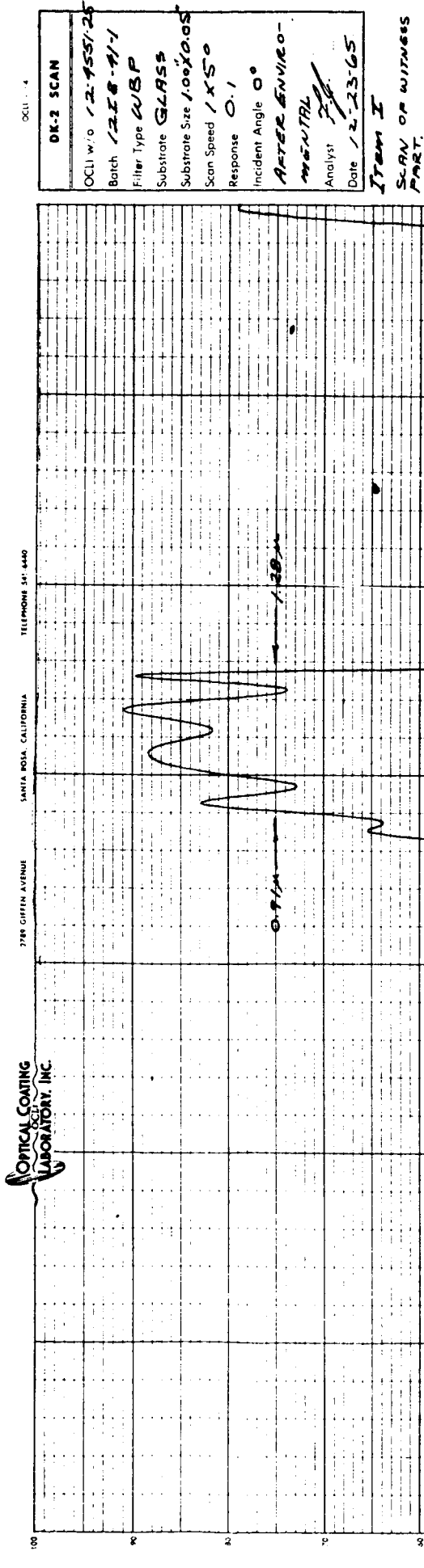
SCAN INSTRUCTIONS:
1--GEARS
48T FRONT
96T BACK
2--SCALE EXPANSION
1X



3749 GIFFEN AVENUE
SANTA ROSA, CALIFORNIA
TELEPHONE 313-4460

**OPTICAL COATING
LABORATORY, INC.**

Figure 4.1



Without OW-1 glass

SCAN INSTRUCTIONS:
 1—GEARS
 48T FRONT
 96T BACK
 2—SCALE EXPANSION
 1X

Figure 4.2

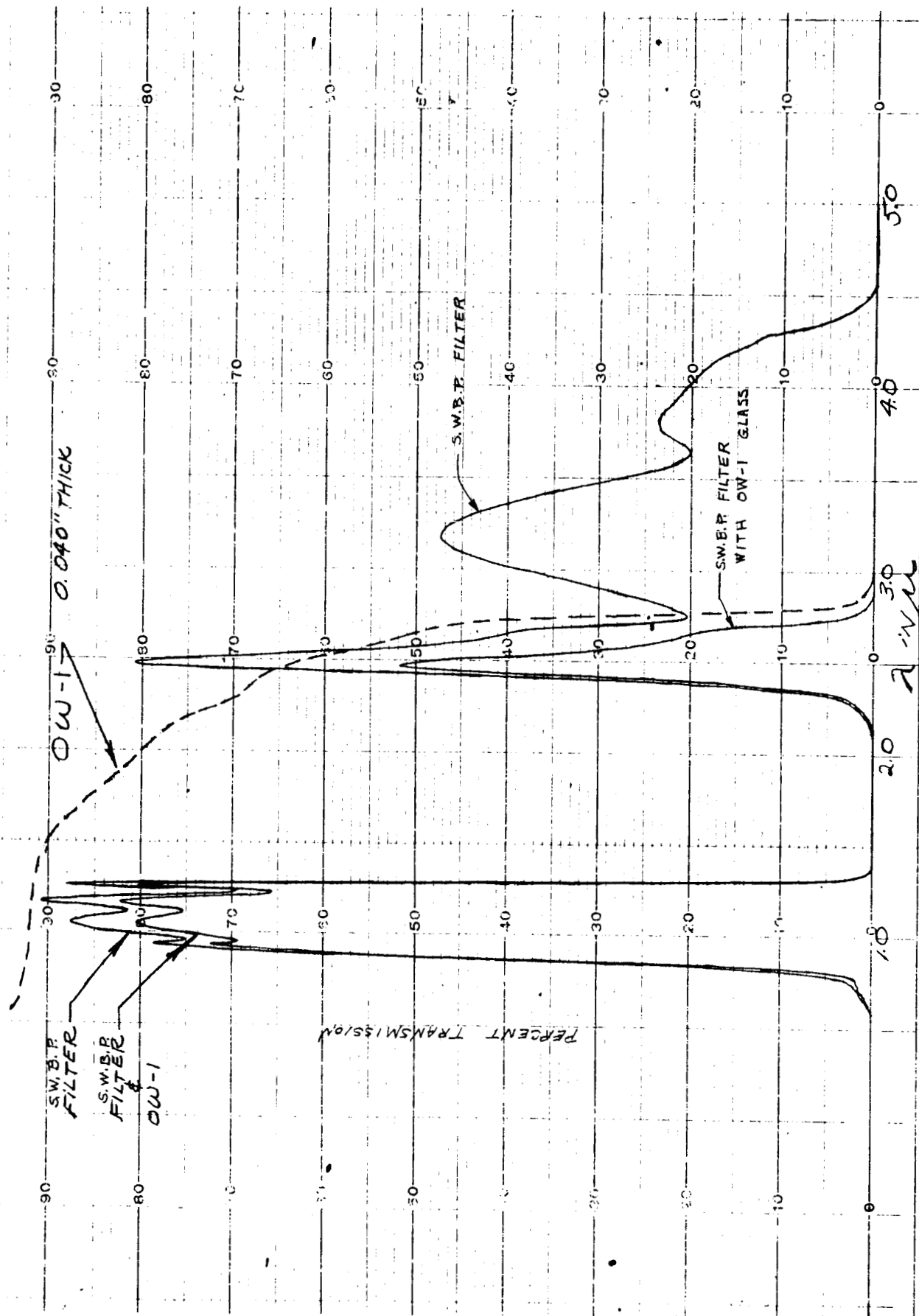


Figure 4.3 Filter Curves



2789 Giffen Avenue
Santa Rosa, California
Telephone (707) 545-6440

☐ CARY 90 SCAN
☒ BECKMAN IR-12 SCAN

OCLI w/o 12-4551-25
Run Number 1253-31-1
Filter Type WBP
Substrate GERMANIUM
Substrate Size 1/2" x 1/2"
Incident Angle 0°
Response Z
Scan Speed 1/10 cm¹/MIN.
cm¹/inch 200
Slit 3x50 Temp. 25°C
Analyst RM Date 12/10/65

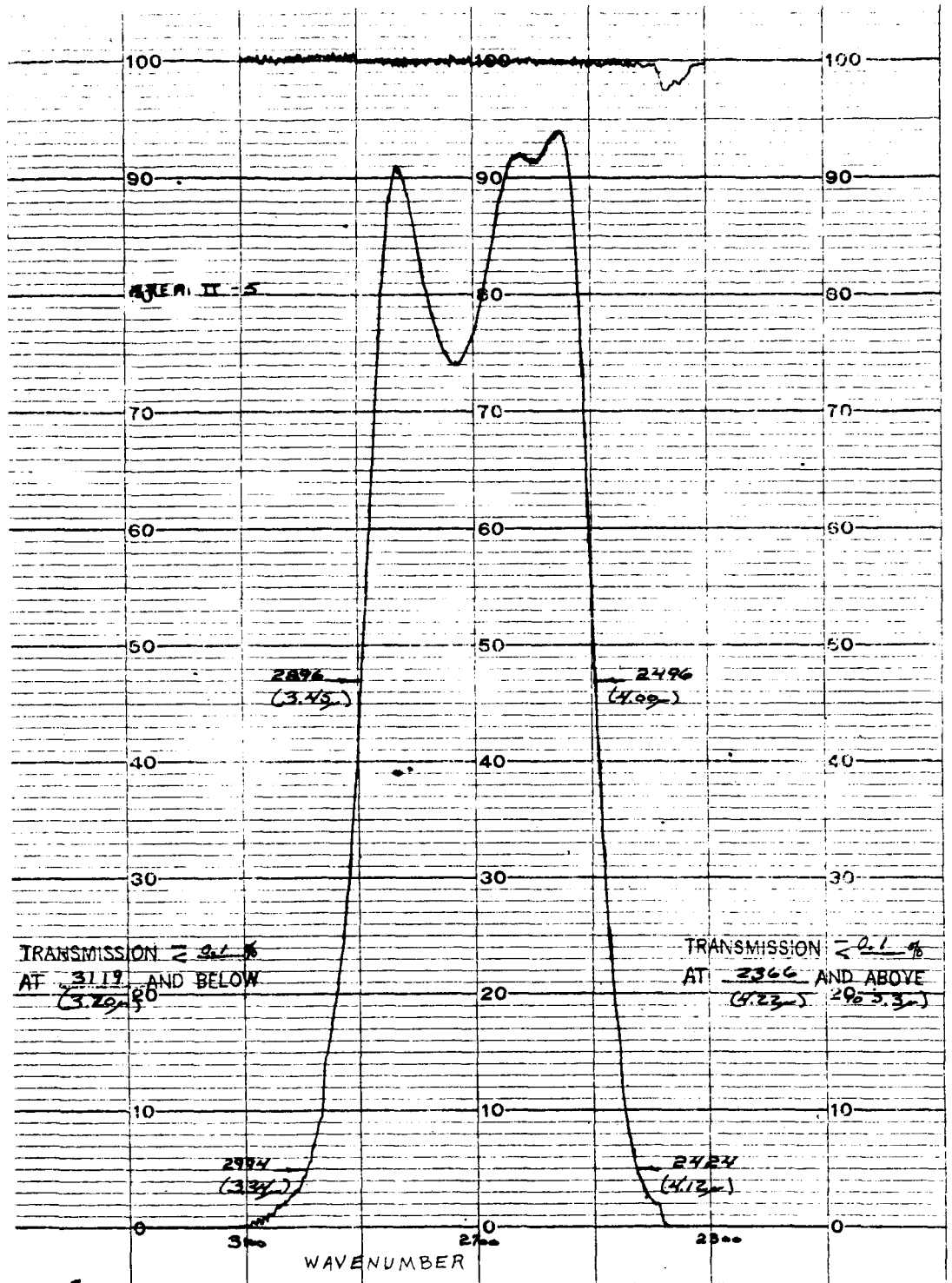
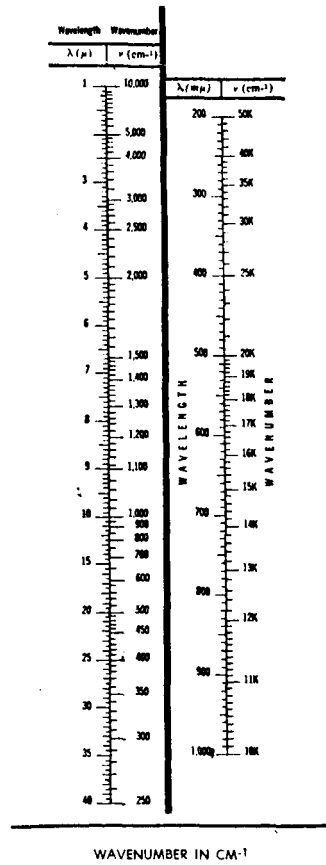


Figure 4.4 Filter Curves

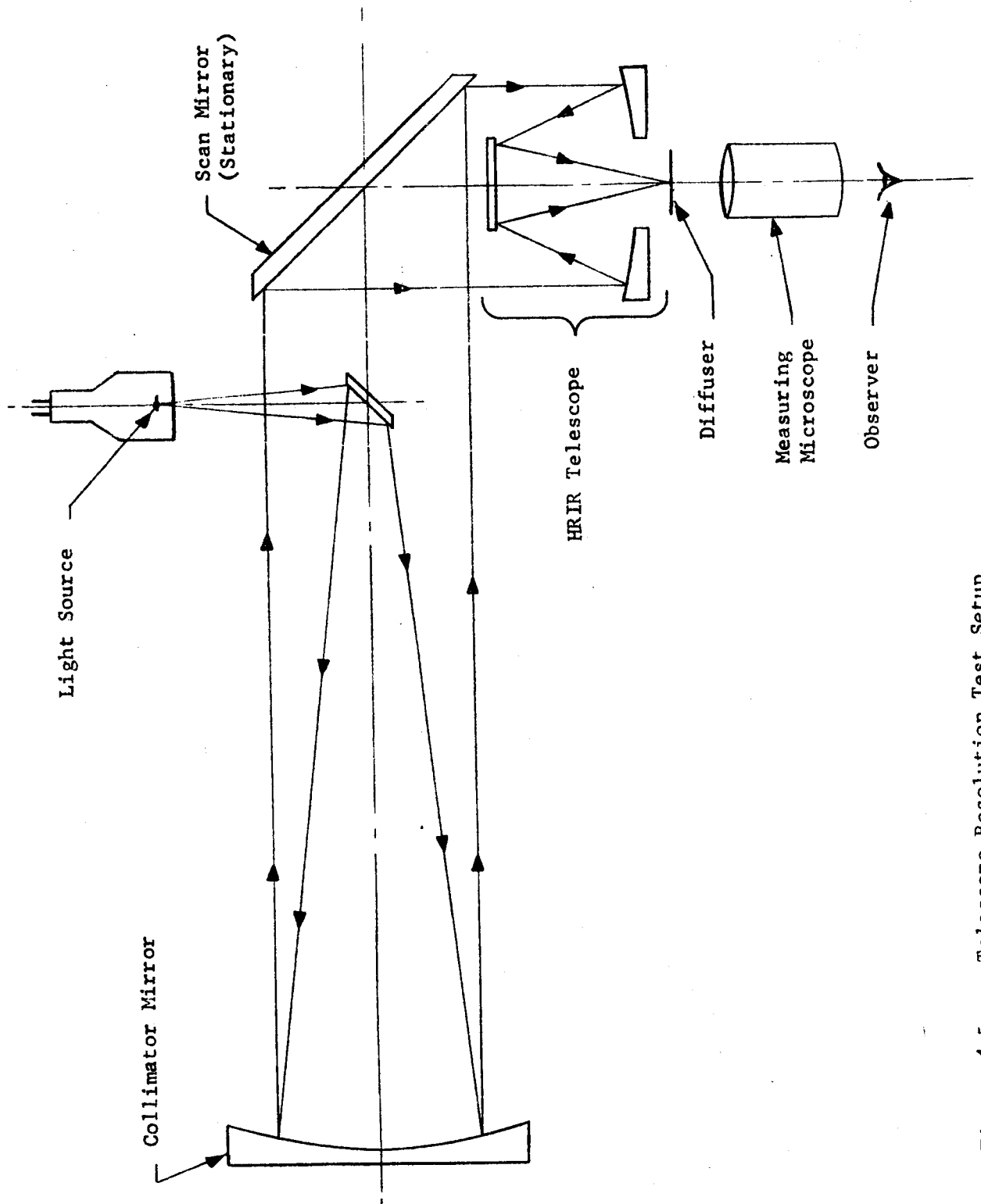


Figure 4.5 Telescope Resolution Test Setup

5.0 ALIGNMENT AND TEST

5.1 Focus and Field of View Tests

5.1.1 Procedure and Equipment

Focusing of the HRIR radiometer and field-of-view measurements are made using a concentrated arc lamp at the focus of a reflective collimator and a mounting fixture for rotation of the radiometer. The concentrated arc lamp is manufactured by Sylvania Electric Products, Inc.; its specifications are listed in Table 5.1. The collimator is a 9.5 inch diameter, f/8 astronomical parabolic reflector manufactured by the Cave Optical Company of Long Beach, California.

Table 5.1 Average Characteristics of Sylvania Concentrated-Arc Lamp-C-2
2 Watts, DC

Voltage across lamp	37 volts dc
Current through lamp	0.055 ampere
Candlepower	0.32 cp
Diameter of Light source	0.085 mm (0.005 in)
Brilliance of light source	56 candles/mm ² (15,000 candles/in ²)

The collimator mirror is diffraction limited on-axis and at small angles (≤ 4 milliradians at a wavelength of 4 microns) from the optic axis. The diffraction diameter (Airy disk) is 0.0384 milliradian at 4 microns. The degree of collimation (beam spread) of the collimated radiation is set by the 0.005-inch diameter of the light source at $\pm 1/32$ milliradian (spot diameter of 0.0625 milliradian). Under these conditions the main effect of diffraction is to redistribute the radiation within the 0.0625 spread angle and not to increase its size. The radiation is therefore collimated to a small fraction of the spot size of the HRIR optics. The on-axis aberration of the HRIR radiometer is from 1.9 to 2.4 milliradians at best focus at the detector (secondary) image plane. It consists of uncorrected spherical aberration and a small amount of coma due to the tilt of the axes of optical elements with respect to one another and to curvature in the scan mirror.

The field of view fixture consists of a vertical mounting plate, to which the radiometer is affixed, which is attached to a rotary milling table. This table can be rotated 360 degrees, and its angular position may be read to an accuracy of 15 seconds of arc (0.067 milliradian). By mounting the radiometer on the fixture in two positions 90 degrees apart, the field of view can be measured across the detector sensitive area in both major axes.

Each radiometer is focused at the prime focus by replacing the chopper disk with a thin mylar sheet. The secondary mirror of the primary telescope is then adjusted until the image of the collimated source has a minimum extent in the plane of the chopper. The image is adjusted to be on the radiometer optical axis and the focusing is done visually by observing the prime focus with a microscope.

The chopper is then put in place and the reflective relay optic (containing the spectral filter) is inserted. The detector cell is mounted on the optical axis at the nominal secondary focal plane during mechanical alignment of the radiometer and the square sensitive area is positioned with two sides parallel to the radiometer scan direction.

The adjustment of the secondary (relay optic) focus and the measurement of the field of view are then made. To begin with the radiometer is rotated about the vertical axis and horizontal axis for a rough measurement of the field of view in the directions parallel and perpendicular to the radiometer scan. The angular settings midway between the measured -6 db electrical points in both directions correspond to the center of the detector element and position where the optical axis intersects the detector. The -6 db electrical points correspond to the -3 db radiant watt points, since radiant watts are transformed into electrical volts by the detector.

The -3 db radiant watt points correspond to the positions where one-half the energy from the collimated beam falls on the detector and are taken as the edges of the field of view. The collimated flux from the concentrated arc lamp passes through the spectral filter in the relay optic. The source provides sufficient energy in the 3.4 to 4.2 micron wavelength region for measurements to be made with an uncooled detector. Measurements are made of the signal amplitude in the video channel prior to compression and demodulation. An electronic filter is used to restrict the bandwidth to 600 cps about the chopper frequency. Each measurement is made with the radiometer and scan mirror stationary and the chopper running.

The radiometer is then set at the angular position between the measured -6 db electrical points (i. e. with the image centered on the detector). The detector element is then moved in and out along the optical axis and rough field of view measurements made. These measurements are used to confirm that the focal changes are made perpendicular to the detector plane (i. e. , that the detector element is perpendicular to the optical axis) and to find the position of maximum on-axis signal.

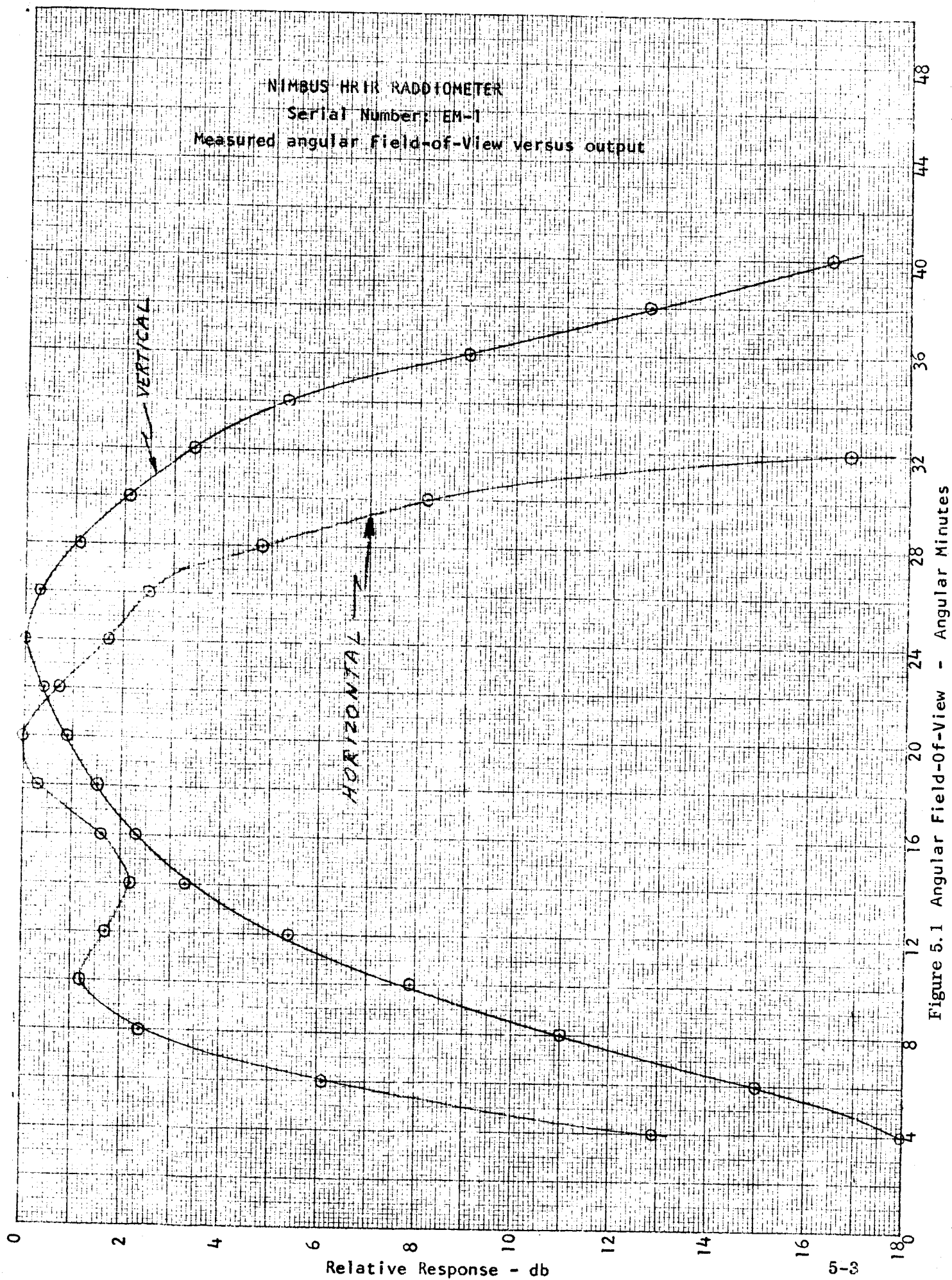


Figure 5.1 Angular Field-Of-View - Angular Minutes

Upon finding the point of maximum on-axis signal, the detector element is locked in position and the final field of view measured is made in each of two mutually perpendicular axes.

5.1.2 Measurements on EM-1

On March 18, the initial focus and field of view measurements were made on the engineering model.

Using the mylar chopper and the procedure as in Section 5.1.1, the telescope was focused at the prime focus point. The spot size on the mylar chopper at focus was approximately 10 mils in diameter.

After focusing, the field of view was measured using the above procedure and found to be 6.6 by 6.7 milliradians. (The specification calls for a FOV of 7.2 milliradians \pm 10 percent.) The curves derived from this measurement are shown in Figure 5.1.

5.2 Space Chamber Tests

During the month of March, a number of tests were run in the vacuum chamber on the assembled engineering model. In all tests the electronics were mounted outside the vacuum chamber in order to facilitate measurements and changes. All testing during initial tests was in the night mode.

5.2.1 Cell Temperature Control

Initial tests of the cell temperature control indicated that control would be adequate, having hysteresis extremes of -72.6 degrees to -74.3 degrees C. This was later adjusted for a colder control point, where the extremes were -76.2 degrees to -77.6 degrees C.

One problem was encountered in this area, in that when the control (patch) diode was switched on, the telemetry reading jumped by 55 mv, returning to normal when the diode switched off. It was found that the common ground wire (Chromel AA) used for both the diode and the measuring thermistor had a resistance of about 8 ohms, causing a voltage drop of 55 mv during diode conduction. This was corrected by replacing the Chromel wire with 5 mil nickel wire having a resistance of only 0.45 ohms.

It was also necessary to decrease the resistor in series with the patch diode from 2000 ohms to 1150 ohms to obtain adequate heat input to maintain control. The diode now inserts about 56 milliwatts of heat into the patch during breakdown conditions.

5.2.2 Cell Bias

It was originally thought that a cell bias on the order of 6 to 12 volts would be required for proper cell operation. For this reason, the voltage divider network consisting of R1, R5, and C1 on the preamplifier-cell control board (Drawing Number 4708379, Quarterly Report XVII, page A-3) was inserted. Eastman Kodak's data then indicated that -18 volts would be the best bias point, so R5 and R1 were removed on the engineering model. During initial testing, excessive 1500 cps interference was noted on the preamplifier signal which was traced directly to the -18 volts power line. This problem was cleared up by making R5 a 10K resistor so that it in conjunction with C1 formed a low-pass R-C filter to effectively eliminate power line "hash" from reaching the detector cell.

5.2.3 Video Processing Operation

Except for the minor gain adjustments, the video chain operated extremely well. The only problem encountered was excessive 60 cps ripple on the video output particularly during high level signals. This was traced to the floating substrates on the MOS-FET transistors used in the quadrature filter. By grounding the substrate electrodes (pin 4) through a 100K resistor, the 60 cps signal was eliminated. The chopper pickup was adjusted for proper phasing, and this adjustment appears to be much less critical than on previous designs.

5.2.4 AGC Operation

For schematic diagrams of applicable circuits refer to Quarterly Report XVII pages A-5, A-6, and A-7.

A considerable amount of effort was directed to testing and refining the AGC network used to correct for the chopper radiation signal. The necessity for this circuit and the operation of it has been widely discussed in previous reports and will not be explained here.

Initially, the AGC did not correct properly due to a design over-sight in which the input to the AGC level sensing circuit was derived from the multiplexed video signal. This did not allow a long enough look at the actual null signal, so the input was changed so that it now comes directly from the output of the low-pass filter on the video output board prior to the multiplexing function. This improved the correction, but it was still inadequate for the warm chopper case. To improve AGC operation the output circuits of the AGC system (Reference - AGC board) were changed to the configuration shown in Figure 5.2. The emitter follower was added to provide for low impedance driving of the quad filter, while the reduction of R25 to 5110 ohms and the addition of CR9 increase the over-all loop gain. R28 and C10 provide for

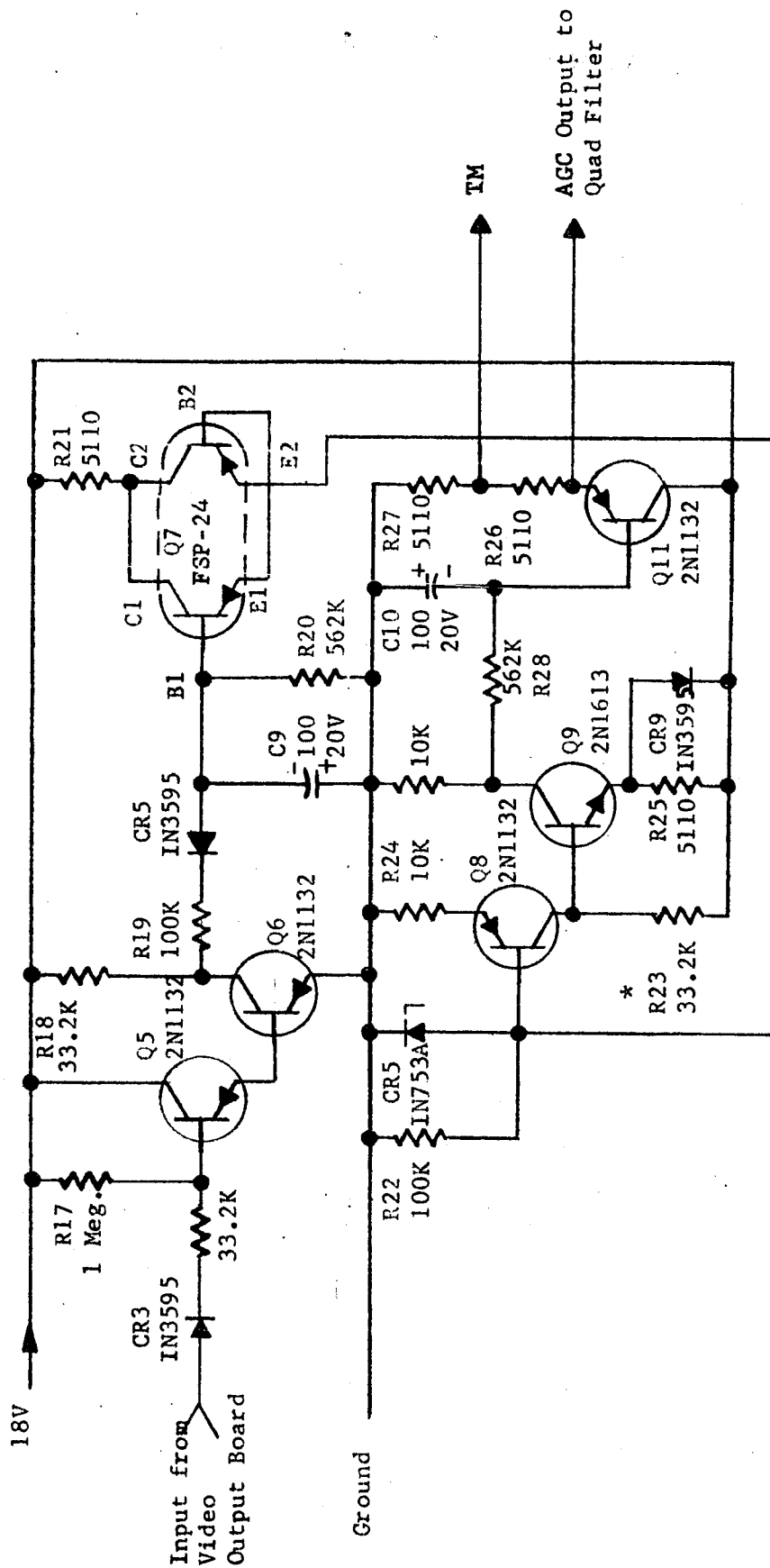


Figure 5.2 AGC Circuit

reduction of the ripple at the scan rate. Series resistor R1 on the video processing board was reduced to 22.6K to effectively reduce the dynamic range required from the AGC circuit.

These changes allowed the system to correct very well except that during cold target conditions, the zero level would tend to bounce and shift level in a negative direction. Reducing the time constant of the system solved this problem immediately. This was accomplished by reducing R19 (Reference - AGC board) from 221K to 100K.

5.2.5 Chopper Noise

From the outset of testing, excessive chopper ripple at the chopper rotational rate (8.33 cps) has been a problem. This chopper signal is seen primarily during low level (cold) target signals, and is due to variations in chopper emissivity around its periphery. On previous models, this was solved by diffusing the chopper disc, however four different diffused choppers have been tried to date without success in the engineering model. One possible reason for this may be that the video signal null during cold target conditions is so much improved by the use of the quadrature filter network that it is possible to see much lower level signals than previously. This chopper ripple problem will be investigated more thoroughly during the next reporting period.

6.0 QUALITY CONTROL

The normal incoming inspection and testing was accomplished on the multitude of parts coming in the company for use on the prototype and flight models. The items that were found discrepant were removed from the acceptable material and returned to the Vendor for corrective action.

On January 14, 1966, a company source inspection was performed at the Eastman Kodak Company, Rochester, N. Y. This source inspection was for the final acceptance of nine type E lead selenide detectors. Of the nine units submitted, six units were accepted for use by ITTIL on the prototype and flight models of the HRIR. A discrepancy was found in the test fixture used to obtain the frequency response characteristics; this condition resulted in a complete new set of data on the units being inspected. The reason the three units were rejected was that the D* was less than the specification limits as called out on ITTIL drawing number 4708255A.

On February 10, 1966, three hysteresis motors and power supplies were received from Herbert C. Rotors. Of the three units received, three were rejected by incoming inspection. Two units were rejected because of improper serialization and one unit was rejected because of damage to the gear teeth. The two units were serialized by ITTIL and the one unit with the damaged gear teeth was returned to the vendor for corrective action. The remaining items on the order were received in excellent condition.

During the month of February, the gear assemblies were received from the New Jersey Gear & Mfg. Co. On the 100 percent inspection, slight discrepancies were detected on most of the units. With the dimensions as called out on the inspection reports, a limited design review was held to determine whether the design tolerances were too tight and possibly could be loosened or whether the parts would have to be returned to the vendor for corrective action. It was determined that some of the tolerances were too tight and could be loosened. In other areas the tolerances were correct as listed; therefore, corrective action was needed. It was agreed that the rework would be accomplished at ITTIL's facilities. The changes were all documented on ECN's and the prints were all updated.

The inspection procedures covering the items received are written and on file. At the completion of the engineering phase of the program, additional in-process inspection procedures will be developed. These procedures will be utilized at the inspection stations called out on the assembly flow chart. This material will be sent to NASA after completion of the engineering model of the HRIR.

1. The units shall be selected Type E lead sel enide detectors cemented to mounts supplied by ITTIL so that the radiation is incident through the detector substrate.

2. The detectivity (D^*) of each detector between 3.4 to 4.2 microns, at a chopping frequency of 1500 cps, and normalized bandwidth of 1 cps shall be equal to or greater than 2.0×10^{10} cm cps $1/2$ watt at -80°C .

3. The time constant at -80°C for each unit shall be equal to or less than 20 microseconds.

4. The detector size shall be .695 mm by .695 mm to within a $\pm 10\%$ tolerance.

5. In addition to the data required to verify 2, 3 and 4 above, the following test data shall be required with each unit:

- Dark resistance at -80°C .
- Response vs. frequency to 5 keps at -80°C .
- Signal, noise and S/N as a function of bias voltage from 3 volts to 18 volts at -80°C .
- Signal vs. detector temperature between -60°C and -90°C .

6. A source inspection as specified by section 5.5 of NASA Q. C. Document NPC 200-2 shall be conducted at the vendors facilities. A representative of ITTIL will, prior to delivery, observe and verify that each unit conforms to the detectivity and time constant specifications as defined by items 2 and 3.

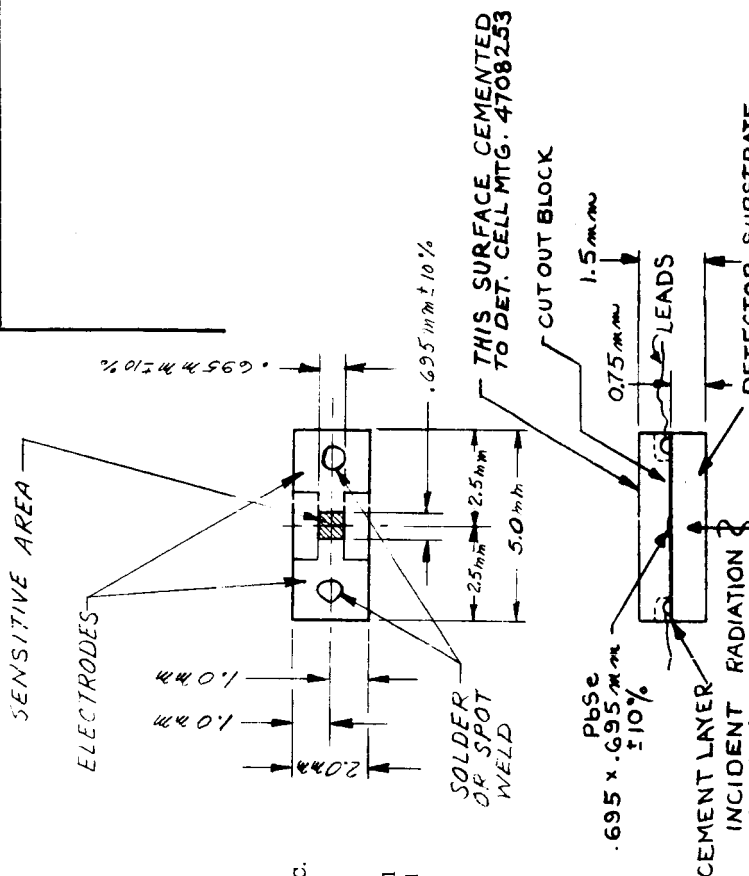
7. A test procedure shall be submitted to ITTIL prior to purchase on how these tests will be conducted.

4708255
REVISIONS

REVISIONS

ZONE A
CHG BY DATE
A. W. J. 11/14/52
ECN NUMBER 152

CORRECTED PICTORIALY AND
ADDED INFORMATION



QTY. ITEM		PART NUMBER		DESCRIPTION		LIST OF MATERIAL	
SIGNATURE & DATE		DRAWN		INDUSTRIAL LABORATORIES FORT WAYNE, IND.		A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION	
CHG.		CHECKED		TYPE E LEAD SELENIDE DETECTOR		SCALE 8:1	
REVISION		APPROVED		INCIDENT RADIATION		SHEET	
STD.		APPROVED		DETECTOR SUBSTRATE		DWG. SIZE	
E O P N		APPROVED		CEMENT LAYER		ISSUE	
MATERIAL		FINISH		LEADS		B-4708255	
PAIR HASSE FROM		ROCHESTER, N.Y.		CUT OUT BLOCK		A	
UNLESS OTHERWISE SPECIFIED		DIMENSIONS ARE IN INCHES AND INCLUDE		TOLERANCES		TYPE E LEAD SELENIDE DETECTOR	
BASIC DIMENSION		DECIMALS		FRACTIONS		TYPE E LEAD SELENIDE DETECTOR	
UNDER 8		± .005		± 1/64		TYPE E LEAD SELENIDE DETECTOR	
8 TO 24 INCL.		± .010		± 1/32		TYPE E LEAD SELENIDE DETECTOR	
OVER 24		± .015		± 1/16		TYPE E LEAD SELENIDE DETECTOR	
ANGLES ± 1/2°		± .015		± 1/16		TYPE E LEAD SELENIDE DETECTOR	
COMMERCIAL TOLERANCES APPLY TO STOCK BULK		SHOP PRACTICE, ESM SECT. M, APPLIES		TYPE E LEAD SELENIDE DETECTOR		TYPE E LEAD SELENIDE DETECTOR	
NEXT ASSEMBLY		FIRST USED ON		TYPE E LEAD SELENIDE DETECTOR		TYPE E LEAD SELENIDE DETECTOR	
APPLICATION		TYPE E LEAD SELENIDE DETECTOR		TYPE E LEAD SELENIDE DETECTOR		TYPE E LEAD SELENIDE DETECTOR	

ITTIL-D-1

7.0 RELIABILITY REPORT

7.1 Reliability Analysis

The initial reliability analysis of the HRIR was completed during the month of January. This report was prepared to provide an initial appraisal of the HRIR design. The analysis includes reliability predictions part stress analysis, and recommendations.

This first estimate of reliability is based on a parts population count to which available fixed part failure rates were assigned. By allocating these failure rates, the probable reliability of the HRIR is shown to be approximately 0.84 for a continuous operating period of 6 months. In terms of MTBF (mean time between failures), the HRIR reliability is 25,106 hours.

Reliability engineering, working in conjunction with design engineering, derived stress figures to determine the actual stress under which each part will be subjected during operation of the system. Stress levels were determined by actual measurements, performed on breadboard and engineering prototype circuits, with reference to the known parts ratings. These stress figures were included as part of the reliability analysis report.

7.2 Parts and Material Selection

A reliability engineering parts specialist has participated in the selection, application review and procurement of the parts included in the HRIR designs. All requisitions for these parts were reviewed and approved by cognizant reliability engineering personnel.

Procurement and screening specifications have been prepared for all parts not covered by existing or detailed specifications. All screening and power aging of parts, whether performed by the vendor or by ITTIL facility, is performed under the cognizance of reliability engineering and as directed by an assigned parts specialist.

A parts list was prepared for all electronic parts incorporated in the breadboard design, and those specified for the HRIR engineering model design. This list includes screening status, quantity of each type used and "where used".

Several recommendations were made regarding over stressed parts and in all cases these have been eliminated in the engineering model.

7.3 Failure Mode, Effect, and Criticality Analyses

The failure mode, effect and criticality analyses were begun during the last part of March. Stress figures and circuit operation form the basis for this analyses along with the review of all schematics and designs for the breadboard and engineering model.